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ABSTRACT

This curriculum guide provides a model for a postsecondary industrial electricity program. It is divided into 10 sections. Section 1 overviews the philosophy, purpose, and goals for vocational education in Georgia. Contents of section 2 include a definition of the guide's purpose and program objective. Section 3 describes the occupational field, discusses employability skills, and provides information on exit points and task listing by Dictionary of Occupational Titles code. Examples of a curriculum structure and course outline are provided in section 4. Section 5 contains the unit guides for 4 units and 109 tasks. Each task contains the following information: task, performance objective, instructional activities, suggested instructional materials, evaluation, and classroom hours. Unit topics are residential wiring, transformers, commercial wiring, and industrial wiring. Section 6 includes an instructional resource matrix, list of textbooks, suppliers of materials, and additional instructional resources. Forms for recording student progress are provided in section 7. Section 8 addresses working with special needs students. Sections 9 and 10 contain facility layouts and definitions of terms. (YLB)

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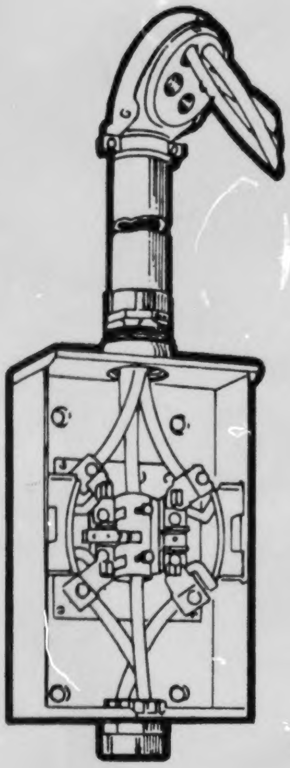
INDUSTRIAL ELECTRICITY

Post Secondary



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CURRICULUM GUIDE

Georgia Department of Education

INDUSTRIAL ELECTRICITY

Developed Under Contractual Agreement with

Division of Program Development
Office of Vocational Education
Georgia Department of Education
Atlanta, Georgia 30334
Charles McDaniel, State Superintendent of Schools
1981

INDUSTRIAL ELECTRICITY

Developed By

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Under the Direction of

Dr. Paul Scott

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POLICIES AND PROCEDURES FOR THE CENTER

PURPOSE OF THE CENTER

The Vocational Education Materials Center functions within the Division of Vocational Education, University of Georgia. This Center operates under grants from the U.S. Office of Education, and the Georgia State Department of Education with the support of the College of Education. The Center is comprehensive in its commitment and approach to the development and dissemination of materials in the broad field of Vocational Education.

The purpose of the Center is to increase the capability of Georgia's delivery system for Vocational Education. Specifically, the Center is committed to:

1. Develop materials to assist in the implementation of proposed curricula and to enhance the teaching of Vocational Education.
2. Conduct and report curriculum research related to Vocational Education.
3. Provide a production and dissemination center for Vocational Education materials.
4. Provide direct experiences in curriculum development and diffusion for advanced graduate students.
5. Enable faculty members to participate in the development and implementation of a variety of curriculum materials.

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SECTION I

PHILOSOPHY & GOALS

VOCATIONAL EDUCATION IN GEORGIA

A. PHILOSOPHY

The Georgia Board of Education perceives vocational education as a vital component in the education of the young and adult citizens of this State. Appropriate programs of vocational education and ancillary services should be made readily available to individuals in middle schools, high schools, postsecondary area vocational-technical schools, vocational divisions of junior colleges, vocational centers, the Quick Start program and other adult programs designed to train or retrain workers for useful and satisfying employment.

Special services and assistance must be provided to those who need it in order to participate or benefit from vocational education. This includes women, minorities, the displaced homemaker and other displaced workers, those with limited English-speaking ability, the disadvantaged and the handicapped.

Since men and women spend the greater part of their lives at some form of work, the State should provide opportunities for all its citizens to develop the knowledge, skills and attitudes necessary for them to secure personally satisfying and socially useful employment.

B. PURPOSE

The purpose of vocational education shall be to improve the economic well-being of Georgia citizens by preparing individuals, through organized learning experiences, to select, obtain and advance in recognized occupations.

POSTSECONDARY VOCATIONAL EDUCATION

A. PURPOSE

The purpose of postsecondary vocational-technical education in Georgia is to improve the economic well-being of adult citizens by providing access to high quality vocational-technical training for skilled and semi-skilled occupations, for improvement of existing skills or for retraining in a new occupation.

B. OBJECTIVES

1. To provide vocational-technical education programs and ancillary services commensurate with the needs and interests of students and available job opportunities.
2. To provide vocational-technical education programs which are current with the state-of-the-art, competency-based, and offer multiple exit points to accomodate the students' occupational objectives.
3. To provide vocational-technical education programs which are articulated with available high school counterparts, to facilitate an easy transition from secondary to postsecondary levels without loss of credit.
4. To provide vocational-technical education programs such that 75% of those individuals who leave or complete a program of occupational preparation will find employment in the field, or a related field, for which trained.
5. To provide those guidance, counseling, financial aid, evaluative, job placement, remedial and other supportive programs and services needed by students to enroll, complete a program and become, or remain, employable in a skilled or semi-skilled occupation.
6. To provide needed assistance to special populations to include women, minorities, limited English-speaking, the displaced homemaker and other displaced workers, the disadvantaged and the handicapped.
7. To provide vocational-technical education programs for full-time and part-time students on campus during the day as well as the evening hours, and to provide appropriate programs for full-time and part-time students off campus in businesses and industries, comprehensive high schools and other locations within the respective schools' service areas.
8. To serve as a center for the delivery of postsecondary and adult vocational-technical education programs and services for the community and assigned service area.

STATEMENT OF LOCAL SYSTEM PHILOSOPHY, PURPOSE AND GOALS FOR VOCATIONAL EDUCATION

SECTION II

PURPOSE & OBJECTIVES

PURPOSE OF GUIDE

The purpose is defined in terms of the functional needs of each of the identified classes of users in the secondary and post secondary systems.

(a) Vocational teachers.

1. Provide a guide for organizing their program of instruction,
2. Assist in establishing program objectives,
3. Serve as a curriculum materials resource guide,
4. Improve communications with employers and advisory committees,
5. Facilitate competency based instruction,
6. Facilitate either group or self-paced instruction,
7. Include content by quarter and semester,
8. Cross-reference with existing state developed instructional materials (PLACE packages and post secondary I.I.).

(b) Vocational supervisors and administrators.

1. Assist in defining the scope and content of their programs,
2. Provide a means to improve curriculum management functions,
3. Serve as a guide for admissions and job placement functions,
4. Improve communications with employers and advisory committees.

(c) Counseling and guidance staff.

1. Provide a data base for counseling and guidance personnel,
2. Identify student exit points (Career Option),
3. Serve as guide for admissions and job placement,
4. Correlate with the new State Board of Education graduation requirements,
5. Provide specific content sequencing by quarter and semester for student scheduling,
6. Provide (a) curriculum options for the disadvantaged handicapped student, (b) curriculum modifications for SPECIAL NEEDS students, (c) typical admission requirements for regular and SPECIAL NEEDS students.

(d) Local Curriculum Coordination Committees.

1. Serve as a guide in working out articulation arrangements,
2. Improve definitions of the relationship between secondary clusters and post secondary specialized programs.

This guide will serve as an ideal communication device between school personnel and the craft advisory committee. By personally reviewing the guide with the local craft advisory committee the teacher will be able to maintain the accuracy of the guide in terms of the local job market and will also be able to inform representatives of local industry regarding the content of the program itself.

INDUSTRIAL ELECTRICITY PROGRAM OBJECTIVE

Given appropriate instruction, as suggested by this guide, a student completing the program should demonstrate entry level skills in Industrial Electricity in the areas of knowledge, theoretical structure, tool usage, diagnostic ability, related supportive skills and occupational survival skills.

As the student progresses through the program, sufficient competencies will be acquired to enable the student to enter the occupational field at the following curriculum exit points.

Electrician Helper	(D.O.T. Code 829.684-022)
Electrician	(D.O.T. Code 824.216-010)

SECTION III

D. O. T. DESCRIPTION, EXIT POINTS, TASKS

DESCRIPTION OF OCCUPATIONAL FIELD

The primary purpose of this section is to provide a general orientation to the occupational field. This orientation may be used by counseling and guidance staff in helping students to select subject areas. It may also be used by instructors for new students just entering the program area. The description delimits the scope of the occupational field in terms of the range of activities involved in a series of occupations. It contains information about career potential within the occupational field, including job market conditions and trends.

The description identifies prerequisite skills and knowledge for those students interested in entering the occupational field. In addition, the Description of Occupational Exit Points are provided to aide the instructor in identifying possible jobs for early leavers. A listing of employability skills is also included in this section.

*INDUSTRIAL ELECTRICITY

Nature of the Work

Heating, lighting, power, air-conditioning, and refrigeration components all operate through electrical systems that are assembled, installed, and wired by electricians. These workers also install electrical machinery, electronic equipment and controls, and signal and communications systems. Maintenance electricians maintain these electrical systems. They spend much of their time doing preventive maintenance. When trouble occurs, they must find the cause and make repairs quickly to prevent costly production losses.

Electricians follow blueprints and specifications for most installations. To install wiring in factories and offices, they may bend, fit, and fasten conduit (pipe or tubing) inside partitions, walls, or other concealed areas. Workers also fasten to the wall small metal boxes that will house electrical devices such as switches.

To complete circuits between outlets and switches, they then pull insulated wires or cables through the conduit. They work carefully to avoid damaging any wires or cables. In lighter construction, such as housing, plastic covered wire usually is used rather than conduit.

In any case, electricians connect the wiring to circuit breakers, transformers, or other components. Wires are joined by twisting ends together with pliers and covering the ends with special plastic connectors. When additional strength is desired, they may use an electric "soldering gun" to melt metal onto the twisted wires, then cover them with durable, electrical tape. When the wiring is finished, they test the circuits for proper connections.

For safety, electricians follow National Electrical Code specifications and procedures and, in addition, must comply with requirements of State, county, and municipal electrical codes.

Electricians generally furnish their own tools, including screwdrivers, pliers, knives, and hacksaws. Employers furnish heavier tools, such as pipe threaders, conduit benders, and most test meters and power tools.

Working Conditions

In a single day, electricians may work in a clean, air-conditioned office and also on a factory floor surrounded by the noise, oil and grease of machinery.

Electricians often climb ladders or work on scaffolds in awkward or cramped positions.

Because maintenance electricians work near high-voltage industrial equipment, they must be alert and accurate. Errors in wiring installations could endanger both the electrician and other employees.

Safety principles, which are a part of all electrician training programs, have reduced the frequency of accidents. Electricians are taught to use protective equipment and clothing, to respect the destructive potential of electricity, and to fight small electrical fires.

Places of Employment

Electricians are employed by electrical contractors and manufacturing industries. A large percent of electricians are self-employed. Electricians are employed throughout the country, but are concentrated in industrialized and urban areas.

Training, Other Qualifications, and Advancement

Many electricians gain knowledge through technical schools. Taking courses in electricity, electronics, algebra, mechanical drawing, shop and science would be beneficial.

All applicants should be in good health and have at least average physical strength. Good color vision is important because workers frequently must identify electrical wires by color. Also important are agility and dexterity. Applicants for apprenticeship positions must be at least 18 years old and usually must be a high school or vocational school graduate with 1 year of algebra.

To obtain a license, necessary for employment in some cities, an electrician must pass an examination which requires a thorough knowledge of the craft and of State and local building codes.

Experienced electricians can advance to supervisors, superintendents, or contract estimators for contractors on construction jobs. Many electricians start their own contracting businesses. In most large urban areas, a contractor must have an electrical contractor's license.

Employment Outlook

Employment of electricians is expected to increase about as fast as the average for all occupations through the 1980's. As population and the economy grow, more electricians will be needed to install electrical fixtures and wiring in new and renovated homes, offices, and other buildings. In addition to jobs created by increased demand for electrical work, many openings will arise as experienced electricians retire, die, or leave the occupation for other reasons. Opportunities will be best for persons with apprenticeship training.

Although employment in this field is expected to grow over the long run, it may fluctuate from year to year due to ups and downs in construction activity. When construction jobs are not available, electricians may transfer to other types of electrical work. For example, they may find jobs as maintenance electricians in factories. Employment in factories is increasing due to growth stemming from greater use of electrical and electronic equipment produced by industry.

Sources of Additional Information

For general information about the work of electricians, contact:

Associated Independent Electrical Contractors of America, 1201 N.
Watson Rd., Suite 201, Arlington, TX 70611

International Brotherhood of Electrical Workers, 1125 15th St.
NW., Washington, DC 20005

National Association of Lighting Maintenance Contractors, 1750
Old Meadow Rd., Suite 3-A, McLean, VA 22102

National Electrical Contractors Association, 7315 Wisconsin Ave.
NW., Washington, DC 20014

National Joint Apprenticeship and Training Committee for the
Electrical Industry, 9700 E. George Palmer Hwy., Lanham,
MD 20802

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*Occupational Outlook Handbook, 1980-81 Edition

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*Related Occupations

824.261-010 ELECTRICIAN

Plans layout, installs, and repairs wiring, electrical fixtures, apparatus, and control equipment. Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes. Prepares sketches showing location of wiring and equipment, or follows diagrams or blueprints, insuring that concealed wiring is installed before completion of future walls, ceilings, and flooring. Measures, cuts, bends, threads, assembles, and installs electrical conduit, using such tools as hacksaw, pipe threader, and conduit bender. Pulls wiring through conduit, assisted by ELECTRICIAN HELPER (any ind.). Splices wires by stripping insulation from terminal leads with knife or pliers, twisting or soldering wires together, and applying tape or terminal caps. Connects wiring to lighting fixtures and power equipment, using handtools. Installs control and distribution apparatus, such as switches, relays, and circuit-breaker panels, fastening in place with screws or bolts, using handtools and power tools. Connects power cables to equipment, such as electric range or motor, and installs grounding leads. Tests continuity of circuit to insure electrical compatibility and safety of components, using testing instruments, such as ohmmeter, battery and buzzer, and oscilloscope. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation, or replacement. May repair faulty equipment or systems. May be required to hold license. May cut and weld steel structural members, using flamecutting and welding equipment.

829.684-022 ELECTRICIAN'S HELPER

Assists ELECTRICIAN to install and repair electrical wiring, fixtures, and equipment, performing any combination of following tasks: Measures, cuts, and bends, wire and conduit, using ruler and handtools. Drills holes for wiring, using power drill, and pulls or pushes wiring through opening. Assists in lifting, positioning, and fastening objects, such as wiring, conduit, and motors. Performs minor repairs, such as replacing fuses, light sockets, bulbs, and switches, using handtools. Maintains tools and equipment and keeps supplies and parts in order. Disassembles defective electrical equipment, such as motors, using handtools.

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*From D.O.T.

EMPLOYABILITY SKILLS

In addition to the aptitudes, abilities, interests, physical requirements and job skills listed in the preceding Description of Occupation, employability skills exert a great deal of influence on a person's ability to get and keep a job. Surveys indicate that more people lose their jobs because of poor attitudes toward their job than for lack of job skills. For this reason it is important that information concerning the following employability skills be provided as an ongoing part of the program.

1. Getting a job
    a. Filling out job applications
    b. Developing a resume
    c. Preparing for a job interview

2. Keeping a job
    a. Be on time and regular in attendance
    b. Maintain a fair share of the work-load
    c. Work without supervision
    d. Meet production schedules
    e. Properly care for and use equipment
    f. Dress appropriately for the job
    g. Maintain good personal hygiene
    h. Develop and maintain good communication with supervisors and co-workers

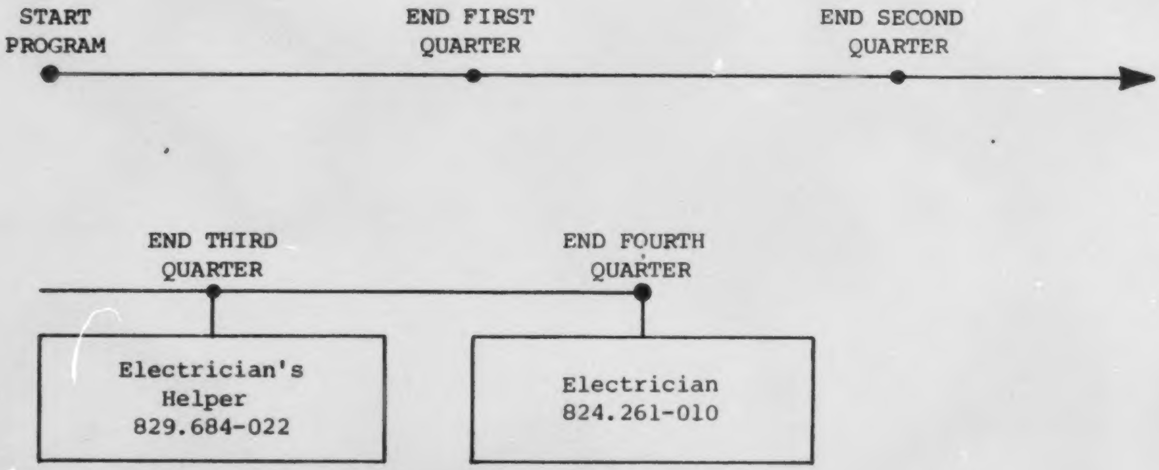
EXIT POINTS BY QUARTER

The diagram on the following page showing the occupational exit points by quarter is based on the suggested Curriculum Structure and the suggested Course Outline presented in this curriculum guide. It graphically illustrates the points in the Industrial Electricity program where the student should have acquired the competencies necessary for entry level employment into the job classifications indicated.

This diagram is based on only one sequence of teaching. The exit points may be rearranged by teaching the units in a different order. This flexibility allows the teacher to sequence the courses according to local preference. It also allows the curriculum to be individualized where individualization is preferred.

EXIT POINTS

INDUSTRIAL ELECTRICITY


START PROGRAM
END FIRST QUARTER
END SECOND QUARTER
END THIRD QUARTER
END FOURTH QUARTER
Electrician's Helper 829.684-022
Electrician 824.261-010

TASK LISTING BY D.O.T. CODE

In this section the occupational exit points from the curriculum are cross referenced with the tasks which are required for employment in each job title. On the line following each task an x appears in the column of each job title to which the task applies. All the tasks listed in this matrix are taught in the curriculum presented in this guide. A detailed treatment of each task appears in the Unit Guides section of this curriculum guide.

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Electrician Helper	Electrician				
	DOT NO.	829.684-022	824.261-010				
TASK NO.	TASK NAME						
	Performance Group - Residential Wiring						
RW-01	Identifying basic electrical theory	X	X				
RW-02	Installing single 115 volt duplex outlets	X	X				
RW-03	Wiring multiple convenience outlets	X	X				
RW-04	Wiring a switch controlled convenience outlet	X	X				
RW-05	Installing three wire branch circuits	X	X				
RW-06	Identifying code requirements for a small appliance circuit		X				
RW-07	Installing split switched receptacles	X	X				
RW-08	Installing a circuit with four receptacles and one single pole switch	X	X				
RW-09	Installing five receptacles on a split circuit	X	X				
RW-10	Wiring one light with a single pole switch and one outlet	X	X				

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

		POSSIBLE EXIT POINTS						
	DOT DESCRIPTIONS	Electrician Helper	Electrician					
	DOT NO.	829.684-022	824.261-010					
TASK NO.	TASK NAME							
RW-11	Wiring a lighting circuit with a single pole switch	X	X					
RW-12	Wiring two lights with a single pole switch	X	X					
RW-13	Wiring two three-way switches	X	X					
RW-14	Wiring two three-way switches with two lights	X	X					
RW-15	Wiring a four way switch controlling one light	X	X					
RW-16	Wiring a master switch	X	X					
RW-17	Identifying electrical symbols		X					
RW-18	Installing electrical symbols into a floor plan and estimating materials		X					
RW-19	Wiring light fixtures	X	X					
RW-20	Hanging light fixtures	X	X					
RW-21	Identifying principles and applications of transformers		X					
RW-22	Wiring low voltage transformers		X					
RW-23	Installing a push button switch		X					

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS: Electrician Helper DOT NO.: 829.684-022	Electrician 824.261-010				
RW-24	Installing bells and chimes		X				
RW-25	Wiring special low voltage circuits		X				
RW-26	Connecting 220 volt grounded outlets		X				
RW-27	Wiring a hot water heater		X				
RW-28	Wiring ranges		X				
RW-29	Wiring baseboard type wall heaters		X				
RW-30	Installing a 230 volt central heating and cooling circuit and disconnect		X				
RW-31	Calculating loads		X				
RW-32	Calculating wire size and voltage drop		X				
RW-33	Making calculations for three-wire branch circuits		X				
RW-34	Selecting conduit for service entrance	X	X				
RW-35	Installing an electrical service for single phase power		X				
RW-36	Installing a circuit breaker box (or a fuse box)	X	X				

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS DOT DESCRIPTIONS: Electrician Helper DOT NO.: 829.684-022	Electrician 824.261-010				
RW-37	Wiring a switch box	X	X				
RW-38	Installing ground fault interruptors		X				
RW-39	Installing a temporary service entrance	X	X				
	Performance Group-Transformers						
T-01	Determining transformer polarity		X				
T-02	Connecting to and operating dual voltage single-phase transformers	X	X				
T-03	Connecting single-phase transformers in series	X	X				
T-04	Connecting single-phase transformers in parallel	X	X				
T-05	Determining the KVA rating of transformers - single-phase	X	X				
T-06	Determing the KVA rating of transformers - three-phase	X	X				
T-07	Hooking up and operating a one-phase auto transformer		X				

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS: Electrician Helper DOT NO.: 829.684-022	Electrician 824.261-010				
T-08	Hooking up a one-phase buck booster transformer		X				
T-09	Hooking up a three-phase booster transformer		X				
T-10	Hooking up a three-phase auto transformer		X				
T-11	Hooking up a three-phase transformer bank; Wye/Wye		X				
T-12	Hooking up a three-phase transformer bank; Delta/Delta		X				
T-13	Hooking up a three-phase bank of transformers; open Delta		X				
T-14	Hooking up a three-phase transformer bank; Wye/Delta		X				
T-15	Hooking up a three-phase transformer bank; Delta/Wye		X				
T-16	Hooking up a three-phase transformer bank; reversed voltage		X				
T-17	Hooking up transformers for special applications		X				

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Electrician Helper	Electrician				
	DOT NO.	829.684-022	824.261-010				
TASK NO.	TASK NAME						
	Performance Group - Commerical						
	Wiring						
CW-01	Calculating service load for a small						
	commercial building		X				
CW-02	Locating service entrance equipment						
	and writing specifications		X				
CW-03	Selecting service entrance conductor	X	X				
CW-04	Calculating service conduits	X	X				
CW-05	Installing service conduit	X	X				
CW-06	Installing service entrance						
	conductors	X	X				
CW-07	Selecting and installing meters	X	X				
CW-08	Selecting and installing panels	X	X				
CW-09	Calculating and installing motor	X	X				
	branch circuits	X	X				
CW-10	Installing and operating subfeeders						
	and panels		X				
CW-11	Grouping outlets onto branch						
	circuits	X	X				
CW-12	Installing specific purpose outlets	X	X				

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

		POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Electrician Helper	Electrician				
	DOT NO.	829.684-022	824.261-010				
TASK NO.	TASK NAME						
CW-13	Calculating branch circuit conductors and overcurrent protection	X	X				
CW-14	Installing branch circuits and controls for lighting	X	X				
CW-15	Selecting conduit	X	X				
CW-16	Installing conduit under a concrete slab		X				
CW-17	Installing outlet, junction and conduitlets	X	X				
CW-18	Installing branch circuits and controls for air conditioning and heating		X				
CW-19	Selecting and installing branch circuits for 3 phase water heaters		X				
	Performance Group - Industrial Wiring						
IW-01	Planning and performing site work for a small industrial facility		X				
IW-02	Making calculations for electric motors, welders and heaters		X				

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Electrician Helper	Electrician				
	DOT NO.	829.684-022	824.261-010				
IW-03	Calculating the 120 and 277 volt lighting load		X				
IW-04	Calculating and selecting receptacles for 120/208 volt loads		X				
IW-05	Calculating size for and selecting and installing a Buss - Duct		X				
IW-06	Selecting and installing a 3 phase, 4 wire 480V panel		X				
IW-07	Selecting the correct transformer bank		X				
IW-08	Selecting and installing a 480v/208-120 3-phase 4 wire service		X				
IW-09	Installing metering equipment		X				
IW-10	Selecting and installing panels and selecting distribution equipment		X				
IW-11	Selecting and installing 277v fluorescent light		X				
IW-12	Determining sizes and types of feeders and overcurrent protection devices		X				

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

TASK NO.	TASK NAME	POSSIBLE EXIT POINTS					
	DOT DESCRIPTIONS	Electrician Helper	Electrician				
	DOT NO.	829.684-022	824.261-010				
IW-13	Installing a branch circuit for welders		X				
IW-14	Operating a split phase motor	X	X				
IW-15	Operating a capacitor start motor	X	X				
IW-16	Operating a universal motor	X	X				
IW-17	Operating a 3 phase induction motor	X	X				
IW-18	Operating a 3 phase synchronous motor		X				
IW-19	Operating a 3 phase 1 winding, 2 speed motor	X	X				
IW-20	Operating a 3 phase 2 winding, 2 speed motor	X	X				
IW-21	Operating single and three phase alternators		X				
IW-22	Operating an induction regulator		X				
IW-23	Operating a rotary frequency changer		X				
IW-24	Operating a synchronous rotary converter		X				
IW-25	Operating a rotary converter		X				
IW-26	Operating DC motors		X				

TASK LISTING BY DOT CODE

INDUSTRIAL ELECTRICITY

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT NO. 829.684-022 DOT DESCRIPTIONS Electrician Helper	DOT NO. 824.261-010 DOT DESCRIPTIONS Electrician				
IW-27	Operating and checking load chacteristics of DC generators		X				
IW-28	Correcting power factor		X				
IW-29	Hooking up and operating gear motors		X				
IW-30	Selecting correct machine drive		X				
IW-31	Installing ventilator fans	X	X				
IW-32	Identifying motor leads	X	X				
IW-33	Identifying hazardous wiring locations	X	X				
IW-34	Operating a power actuated tool	X	X				

SECTION IV

CURRICULUM STRUCTURE & COURSE OUTLINE

CURRICULUM STRUCTURE

The following example of a curriculum structure is provided to illustrate one way an Industrial Electricity curriculum may be structured. The example is not intended to imply that there are not other ways to structure the curriculum.

This curriculum structure is based on the Suggested Course Outline that follows and is an example of one of the successful Industrial Electricity programs within Georgia. The actual amount of time required for each course will vary according to local program objectives and depend upon the instructor, the students and facilities available.

Instructors are encouraged to structure their curriculum and make time estimates based on their experiences, industry requirements, student's needs and the local facilities (classroom, equipment, lab) available.

INDUSTRIAL ELECTRICITY CURRICULUM STRUCTURE

Course Number	Course	Clock Hours
	First Quarter	
	Orientation	3
	Consumer Education	20
	Basic Electricity, D.C. Theory	124
	Basic Electricity, A.C. Theory	30
	Safety	10
	Residential Wiring	125
		Total 312
	Second Quarter	
	A.C. Theory	30
	Transformers	270
	Safety	12
		Total 312
	Third Quarter	
	Communication Skills	30
	A.C. Theory	15
	Trade Math	15
	NEC	40
	Conduit Bending	27
	Commercial Wiring	185
		Total 312

Course Number	Course	Clock Hours
	Fourth Quarter	
	NEC	13
	Industrial Wiring	299
		Total 312
		Four Quarter Total 1248

Course Outline

The sample course outline is to be used as an example to facilitate the development of alternative outlines for the individual learner. The listing of the tasks within a quarter is not meant to indicate a required sequence or pattern. All the tasks are independent; therefore, a group of students may begin the quarters by learning different tasks. This allows better coordination of the laboratory hours and the learning objectives may be selected according to the type of laboratory facilities available. The specific information required to teach the skills for each unit/task is included on the corresponding unit guide sheet in the Unit Guide section.

The time estimations for completion of the activities are expressed as a minimum and should be extended according to the learner's individual needs. The laboratory hours are included in each performance group.

Suggested Course Outline Structure for Industrial Electricity

Quarter I

Unit/Task	Title	Classroom and Laboratory Hours
	Performance Group - Residential Wiring	
RW-01	Identifying basic electrical theory	154
RW-02	Installing single 115V duplex outlets	3
RW-03	Wiring multiple convenience outlets	4
RW-04	Wiring a switch controlled convenience outlet	3
RW-05	Installing three-wire branch circuits	4
RW-06	Identifying code requirements for a small appliance circuit	10
RW-07	Installing split switched receptacles	3
RW-08	Installing a circuit with four receptacles and one single pole switch	3
RW-09	Installing five receptacles on a split circuit	3
RW-10	Installing one light with a single pole switch and one outlet	3
RW-11	Wiring a lighting circuit with a single pole switch	3
RW-12	Wiring two lights with a single pole switch	3
RW-13	Wiring two three-way switches	2
RW-14	Wiring two three-way switches with two lights	2
RW-15	Wiring a four-way switch controlling one light	2
RW-16	Wiring a master switch	2
RW-17	Identifying electrical symbols	6
RW-18	Installing electrical symbols into a floor plan and estimating materials	6
RW-19	Wiring light fixtures	4
RW-20	Hanging light fixtures	3
RW-21	Identifying principles and applications of transformers	5
RW-22	Wiring low voltage transformers	3
RW-23	Installing a push button switch	2
RW-24	Installing bells and chimes	2
RW-25	Wiring special low voltage circuits	2
RW-26	Connecting 220V grounded outlets	3
RW-27	Wiring a hot water heater	2
RW-28	Wiring a range	2
RW-29	Wiring baseboard type wall heaters	3
RW-30	Installing a 230V central heating and cooling circuit and disconnect	3
RW-31	Calculating loads	3
RW-32	Calculating wire size and voltage drop	3

Unit/Task	Title	Classroom and Laboratory Hours
RW-33	Making calculations for three-wire branch circuits	3
RW-34	Selecting conduit for service entrance	2
RW-35	Installing an electrical service for single phase power	4
RW-36	Installing a circuit breaker box (or a fuse box)	3
RW-37	Wiring a switch box	3
RW-38	Installing ground fault interruptors	3
RW-39	Installing a temporary service entrance	5
	Quarter I - Classroom and Laboratory Hours:	279
	Quarter I - Related Instruction Hours:	33
	Total Quarter Hours:	312

Quarter II

Unit/Task	Title	Classroom and Laboratory Hours
	Performance Group - Transformers	
T-01	Determining transformer polarity	30
T-02	Connecting to and operating dual voltage single phase transformers	15
T-03	Connecting single phase transformers in series	15
T-04	Connecting single phase transformers in parallel	20
T-05	Determining the KVA rating of transformers - single phase	10
T-06	Determining the KVA rating of transformers - three phase	10
T-07	Hooking up and operating a one-phase auto transformer	10
T-08	Hooking up a one-phase back booster transformer	10
T-09	Hooking up a three-phase transformer	10
T-10	Hooking up a three-phase auto transformer	10
T-11	Hooking up a three-phase transformer bank; Wye/Wye	30
T-12	Hooking up a three-phase transformer bank; Delta/Delta	30
T-13	Hooking up a three-phase transformer bank; Open Delta	20
T-14	Hooking up a three-phase transformer bank; Wye/Delta	20
T-15	Hooking up a three-phase transformer bank; Delta/Wye	20
T-16	Hooking up a three-phase transformer bank; reverse voltage	20
T-17	Hooking up transformers for special applications	20

Quarter II - Classroom and Laboratory Hours:	300
Quarter II - Related Instruction Hours:	12
Total Quarter Hours:	312

Quarter III

Unit/Task	Title	Classroom and Laboratory Hours
	Performance Group - Commercial Wiring	
CW-01	Calculating service load for a small commercial building	15
CW-02	Locating service entrance equipment	5
CW-03	Selecting service entrance conductor	10
CW-04	Calculating service conduits	10
CW-05	Installing service conduit	10
CW-06	Installing service entrance condutors	10
CW-07	Selecting and installing meters	10
CW-08	Selecting and installing panels	10
CW-09	Calculating and installing motor branch circuits	10
CW-10	Installing specific purpose outlets	10
CW-11	Grouping outlets onto branch circuits	10
CW-12	Installing specific purpose outlets	10
CW-13	Calculating branch circuit conductors and overcurrent projection	10
CW-14	Installing branch circuits and controls for lighting	10
CW-15	Selecting conduit	5
CW-16	Installing conduit under a concrete slab	10
CW-17	Installing outlet, junction and conduitlets	10
CW-18	Installing branch circuits and controls for air conditioning and heating	10
CW-19	Selecting and installing branch circuits for three-phase water heaters	10
	Quarter III - Classroom and Laboratory Hours:	185
	Quarter III - Related Instruction Hours:	127
	Total Quarter Hours:	312

Quarter IV

Performance Group - Industrial Wiring

Unit/Task	Title	Classroom and Laboratory Hours
IW-01	Planning and performing site work for a small industrial facility	10
IW-02	Making calculations for electric motors, welders and heaters	10
IW-03	Calculating the 120 and 277 volt lighting load	10
IW-04	Calculating and selecting receptacles for 120/208 volt loads	10
IW-05	Calculating size for and selecting and installing a Buss-Duct	10
IW-06	Selecting and installing a 3 phase, 4 wire 480 volt panel	10
IW-07	Selecting the correct transformer bank	6
IW-08	Selecting and installing a 480V/208-120 three-phase, four-wire service	10
IW-09	Installing metering equipment	10
IW-10	Selecting and installing panels and selecting distribution equipment	10
IW-11	Selecting and installing 277V fluorescent light	8
IW-12	Determining sizes and types of feeders and overcurrent protection devices	10
IW-13	Installing a branch circuit for welders	10
IW-14	Operating a split phase motor	8
IW-15	Operating a capacitor start motor	8
IW-16	Operating a universal motor	8
IW-17	Operating a 3 phase induction motor	8
IW-18	Operating a 3 phase synchronous motor	10
IW-19	Operating a 3 phase 1 winding, 2 speed motor	8
IW-20	Operating a 3 phase 2 winding, 2 speed motor	8
IW-21	Operating single and three phase alternators	8
IW-22	Operating an induction regulator	5
IW-23	Operating a rotary frequency changer	8
IW-24	Operating a synchronous rotary converter	8
IW-25	Operating a rotary converter	8
IW-26	Operating DC motors	8
IW-27	Operating and checking load characteristics of DC generators	10
IW-28	Correcting power factor	10
IW-29	Hooking up and operating gear motors	10
IW-30	Selecting correct machine drive	10
IW-31	Installing ventilator fans	10
IW-32	Identifying motor leads	8

Unit/Task	Title	Classroom and Laboratory Hours
IW-33	Identifying hazardous wiring locations	6
IW-34	Operating a power actuated tool	8
	Quarter IV - Classroom and Laboratory Hours:	299
	Quarter IV - Related Instruction Hours:	13
	Total Quarter Hours:	312

SECTION V

UNIT GUIDES

UNIT GUIDES

Description

In this section the tasks to be taught in each course are presented in sequential order. Each task is listed on a separate page so that it may be taken out of the guide for daily lesson planning or regrouped with other tasks to fit the individual teacher's own preference for teaching order. The task pages may be used for planning and executing group instruction or for individualized instruction. Each page in the UNIT GUIDES section contains the following information:

TASK: This is a short and concise statement of the task to be taught.

PERFORMANCE OBJECTIVE: The performance expected of the student after completing the unit is stated in stem form, without a specific statement of all conditions, equipment, and performance standard (these are listed in a criterion referenced measure in the Evaluation section of the task page).

INSTRUCTIONAL ACTIVITIES: Suggested learning activities are presented. These activities include providing information, demonstration, use of audio visuals, and practical applications.

INSTRUCTIONAL MATERIALS: The materials that are necessary to carry out the instructional activities are listed. These include textbooks, audio visuals and equipment.

EVALUATION: This section contains a criterion referenced measure (where appropriate) and reference to any test items or other evaluation measures that are available to the teacher. The criterion referenced measure contains three parts--Condition, Performance and Standard.

CLASSROOM HOURS: The estimated time for completion of the instructional activities and the evaluation are indicated. This time estimate is stated in hours of classroom time related to each task.

TASK

RW-01 Identifying basic electrical theory

PERFORMANCE OBJECTIVE

Define the theory and nature of electricity.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The atom
b. Lightning
c. Types of insulators
d. Types of conductors
e. Direct current
f. Alternating current
g. Defining volts
h. Defining watts
i. Defining amperes
j. Describing loads
k. Calculating loads
l. Defining electrical terms
m. Ohm's law
n. Types of connections
o. Types of splices
p. Making splices

Provide Demonstration On:

Making connections and splices

Provide Practical Application On:

a. Draw two atoms, one positive, one negative.
b. Work problems using Ohm's law.
c. Work problems using power formula.
d. Figure voltage drop using Ohm's law and resistance formula.
e. Make several types of connections and splices.

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring
b. Alerich
c. AAVIM, Understanding Electricity and Electrical Terms

A/Vs:

Georgia, slide/tape, EL-01, Electricity (Post Secondary), "Understanding Basic Electrical Theory"

Student Manuals:

a. Georgia, Industrial Electricity, Residential Wiring, Units RW-1a and RW-7a
b. Georgia, Electricity: Post Secondary, Unit EL-01
c. Georgia, Construction Cluster, Basic Electrical Theory, Units BET-1 through BET-10

Tools and Equipment:

(continued on back)

CLASSROOM HOURS

154

EVALUATION (RW-01)

Given an overview of basic electrical theory, the student will describe, diagram and define essential terms and elements, make connections and splices, identify types of flow and determine where and why each is utilized and calculate loads using Ohm's law and the power formula. All tasks must be in accordance with the instructor's specifications.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Selection of wires
b. Wire strippers

TASK

RW-02 Installing a single 115 volt duplex outlet

PERFORMANCE OBJECTIVE

Wire a single 115 volt duplex convenience outlet which conforms to NEC standards.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of circuits
b. Types of outlets
c. Types of conductors
d. Designing the circuit
e. Diagramming the circuit
f. The NEC
g. Using electric meters
h. Selection of materials
i. Selection of tools
j. Types of splices
k. Wiring the circuit
l. Safety

Provide Demonstration On:

Using voltohmmeter

Provide Practical Application On:

a. Diagram a circuit for a 115 volt duplex outlet.
b. Wire a 115 volt duplex outlet.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mix
b. AAVIM, Electrical Wiring

A/Vs:

a. Georgia, slide/tape, REW-01a, Residential Electrical Wiring: Secondary, "Installing Convenience Outlets"
b. Georgia, slide/tape, W-22, Construction Cluster, "115 Volt Outlet"

Student Manuals:

a. Georgia, Construction Cluster, Volt Outlets, Unit VO-1
b. Georgia, Residential Electrical Wiring: Secondary, Unit REW-01

Tools and Equipment:

(continued on back)

CLASSROOM HOURS 3

EVALUATION (RW-02)

Given necessary tools, supplies and equipment, the student will wire a single 115 volt duplex convenience outlet which conforms to NEC standards

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Duplex receptacle
b. Wire
c. Screws
d. Screwdriver
e. Voltohmmeter
f. Wire stripper
g. NEC Handbook

TASK

RW-03 Wiring multiple convenience outlets

PERFORMANCE OBJECTIVE

Diagram, identify and wire a circuit with multiple convenience outlets.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of circuits
b. Types of outlets
   1. Convenience
   2. Appliance
c. Designing the circuit
d. Diagramming the circuit
e. Selection of materials
f. Selection of tools
g. Types of splices
h. Safety
i. Wiring the circuit

Provide Demonstration On:

Designing a circuit with multiple convenience outlets

Provide Practical Application On:

Diagram and wire a circuit with multiple convenience outlets.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mix
b. AAVIM, Electrical Wiring

A/Vs:

Georgia, slide/tape, REW-02a, REW-02b and REW-02c, Residential Electrical Wiring: Secondary, "Installing Convenience Outlets"

Student Manuals:

a. Georgia, Construction Cluster, Volt Outlets, Unit VO-2
b. Georgia, Residential Electrical Wiring: Secondary, Unit REW-02

Tools and Equipment:

a. Receptacles
b. Wire
c. Screws
d. Screwdriver

(continued on back)

CLASSROOM HOURS 4

EVALUATION (RW-03)

Given appropriate tools, supplies and equipment, the student will design, diagram and wire a circuit with multiple convenience outlets. The circuit must conform to NEC standards.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. Voltohmmeter
f. Wire stripper
g. NEC Handbook

TASK

RW-04 Wiring a switch controlled convenience outlet

PERFORMANCE OBJECTIVE

Wire a switch controlled convenience outlet.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of switches
b. How a switch operates
c. Selection of switches
d. Designing the circuit
e. Diagramming the circuit
f. Selection of materials
g. Safety in wiring switches
h. Wiring a circuit with a switch

Provide Demonstration On:

Wiring a switch controlled convenience outlet

Provide Practical Application On:

Wire a switch controlled convenience outlet.

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring
b. Alerich
c. Mix

A/Vs:

a. Georgia, slide/tape, REW-03a, Residential Electrical Wiring: Secondary, "Installing Lighting Outlets"
b. Georgia, slide/tape, W-23, Construction Cluster, "Switches Outlets"

Student Manuals:

a. Georgia, Construction Cluster, Volt Outlets, Unit VO-3
b. Georgia, Residential Electrical Wiring: Secondary, Unit REW-03a
c. Georgia, Industrial Electricity, Residential Wiring, Unit RW-1

Tools and Equipment:

(continued on back)

CLASSROOM HOURS 3

EVALUATION (RW-04)

Given appropriate tools, materials and supplies, the student will wire a switch controlled convenience outlet according to NEC standards.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Receptacles
b. Switches
c. Wire
d. Screws
e. Screwdriver
f. Voltohmmeter
g. Wire stripper
h. NEC Handbook

TASK

RW-05 Installing three-wire branch circuits

PERFORMANCE OBJECTIVE

Install three-wire branch circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Small appliance circuit for kitchen and laundry
b. Three-wire branch circuit for fixed application
c. Branch circuits for a bathroom heater vent light and receptacles using GFCL
d. Branch circuits for 220-230 volt major appliances

Provide Practical Application On:

a. Wire small appliance branch circuits for the kitchen.
b. Wire branch circuits for fixed appliances.
c. Wire a bathroom heater vent light using GFCL.
d. Install a 230v branch circuit for a small dryer.

INSTRUCTIONAL MATERIALS

Textbooks:

a. NEC Handbook
b. AAVIM, Electrical Wiring

Student Manuals:

a. Georgia, Industrial Electricity, Residential Wiring, Units RW-13, RW-14 and RW-15
b. Georgia, Industrial Electricity, NEC Handbook, Units NEC-6 and NEC-48

Tools and Equipment:

(continued on back)

CLASSROOM HOURS 4

EVALUATION (RW-05)

Given appropriate tools, supplies and equipment, the student will correctly wire 115v branch circuits as required for receptacles and fixed appliances for a residence. The finished product must be in accordance with NEC standards.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Small appliances, fixed appliances, bathroom heater vent light
b. Receptacles
c. Conductor
d. Wire strippers, pliers, screwdriver, tape measure
e. Wire nuts
f. Voltohmmeter

TASK

RW-06 Identifying code requirements for a small appliance circuit

PERFORMANCE OBJECTIVE

Identify code requirements for a small appliance circuit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Branch circuits required
   1. Section 220-2, NEC
   2. Small appliance branch circuits
   3. Laundry branch circuits

b. Load evenly proportioned among branch circuits

Provide Practical Application On:

Diagram a small appliance receptacle circuit on a kitchen floor plan.

INSTRUCTIONAL MATERIALS

Textbooks:

a. NEC Handbook
b. AAVIM, Electrical Wiring

Student Manuals:

Georgia, Industrial Electricity, Residential Wiring, Unit RW-12

Tools and Equipment:

Kitchen floor plan

CLASSROOM HOURS 10

EVALUATION (RW-06)

Given an overview of NEC codes for small appliance circuits, the student will correctly diagram all necessary small appliance circuits on a kitchen floor plan. The diagram must be in accordance with NEC standards.

TASK

RW-07 Installing split switched receptacles

PERFORMANCE OBJECTIVE

Design and install split and switched receptacles.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Difference between a switched receptacle and a convenience outlet
b. Designing a switched receptacle
c. Installing a switched receptacle
d. Installing a split switched receptacle

Provide Demonstration On:

Designing a switched receptacle

Provide Practical Application On:

a. Install a split switched receptacle.
b. Install a split receptacle.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Smith
b. AAVIM, Electrical Wiring
c. Alerich

A/Vs:

Georgia, slide/tape, REW-04a and REW-04b, Residential Electrical Wiring: Secondary, "Installing Split and Switched Receptacle"

Student Manuals:

Georgia, Residential Electrical Wiring: Secondary, Unit REW-04

Tools and Equipment:

a. Wire strippers
b. Split switched receptacle
c. Screwdriver
d. Pliers
e. Voltohmmeter

CLASSROOM HOURS

3

EVALUATION (RW-07)

Given appropriate tools, supplies and equipment, the student will design and install split and switched receptacles according to the instructor's requirements.

TASK

RW-08 Installing a circuit with four receptacles and one single pole switch

PERFORMANCE OBJECTIVE

Install a circuit with four rexeptacles and one single pole switch.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Feeders
   1. Diagramming feeder and branch circuits
   2. Maximum voltage drop for feeders
b. Common neutral feeder
c. Overcurrent protection
d. Determining feeder size
e. Vóltage drop formula
f. Continuous load
g. Noncoincident load
h. Maximum distance between receptacles in a residence
i. Minimum number of small appliance circuits for a residence
j. Feeder and service allowance for small appliance circuits
k. Calculating load
l. Designing a circuit with four receptacles and one single-pole switch
m. Wiring the circuit
n. Wiring for receptacles in parallel with one receptacle controlled by two three-way switches

Provide Practical Application On:

Wire a circuit with four receptacles and one single-pole switch so that three receptacles are hot and one is controlled by a single-pole switch

INSTRUCTIONAL MATERIALS

Textbooks:

NEC Handbook

A/Vs:

Georgia, slide/tape, W-24, Construction Cluster, "Single Pole Switches"

Student Manuals:

a. Georgia, Industrial Electricity, Residential Wiring, Units RW-7 and RW-8
b. Georgia, Industrial Electricity, NEC Handbook, Units NEC-5 and NEC-6

Tools and Equipment:

a. Receptacles
b. Switches
c. Wire

(continued on next page)

CLASSROOM HOURS 3

EVALUATION (RW-08)

Given appropriate tools, supplies and equipment, the student will design, diagram and wire a circuit with four receptacles and one single pole switch with three receptacles always hot and one controlled by the switch. All installations will be in accordance with NEC standards.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. Wire strippers
e. Pliers
f. Screwdriver
g. Voltohmmeter

TASK

RW-09 Installing five receptacles on a split circuit

PERFORMANCE OBJECTIVE

Install five receptacles on a split circuit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reason for splitting a receptacle
b. Split circuits
c. Installing split circuits

Provide Demonstration On:

Removing a break-out link from a receptacle

Provide Practical Application On:

Wire a split circuit with five receptacles and one split switch so that the top half of each receptacle is controlled by a switch and the bottom half remains hot.

INSTRUCTIONAL MATERIALS

Textbooks:

AAVIM, Electrical Wiring

Student Manuals:

Georgia, Industrial Electricity, Residential Wiring, Unit RW-9

Tools and Equipment:

a. Receptacles
b. Single pole switch
c. Wire
d. Wire strippers
e. Pliers
f. Screwdriver
g. Voltohmmeter

CLASSROOM HOURS 3

EVALUATION (RW-09)

Given appropriate tools, supplies and equipment, the student will design and wire a circuit within five receptacles and one split switch with the top half of each receptacle controlled by the switch and the bottom half remaining hot. All installations will be in accordance with NEC specifications.

TASK

RW-10 Wiring one light with a single pole switch and one outlet

PERFORMANCE OBJECTIVE

Diagram, identify and wire a circuit with one light controlled by a single pole switch and one hot convenience outlet.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of single pole switches
b. Types of outlets
c. Wiring combinations
d. Designing the circuit
e. Diagramming the circuit
f. Selection of materials
g. Wiring combination of single pole switch and outlets

Provide Demonstration On:

Wiring combination of single pole switch and hot outlets

Provide Practical Application On:

Wire a combination of a single pole switch and one outlet.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mix
b. AAVIM, *Electrical Wiring*

A/Vs:

Georgia, slide/tape, W-25, *Construction Cluster*, "Light with a Single Pole Switch and an Outlet That Is Always Hot"

Student Manuals:

Georgia, *Construction Cluster*, *Overhead Lighting*, Units OL-1 and OL-2a

Tools and Equipment:

a. Single pole switch
b. Receptacle
c. Wire
d. Wire strippers
e. Screwdriver
f. Voltohmmeter
g. *NEC Handbook*

CLASSROOM HOURS 3

EVALUATION (RW-10)

Given appropriate tools, supplies, and equipment, the student will wire one light with a single pole switch and one outlet in accordance with NEC standards.

TASK

RW-11 Wiring a lighting circuit with a single pole switch

PERFORMANCE OBJECTIVE

Draw, identify and wire a simple lighting circuit with a single pole switch.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of switches
b. Types of overhead lighting
c. Designing the circuit
d. Diagramming the circuit
e. Selection of materials
f. Wiring the circuit

Provide Demonstration On:

Wiring a single pole switch

Provide Practical Application On:

Wire a lighting circuit with a single pole switch.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. AAVIM, Maintaining the Lighting and Wiring System

A/Vs:

Georgia, slide/tape, W-24 Construction Cluster, "Single Pole Switches"

Student Manuals:

Georgia, Contruction Cluster, Overhead Lighting, Unit OL-1

Tools and Equipment:

a. Single pole switches
b. Light box
c. Wire
d. Screws
e. Screwdriver
f. Voltohmmeter
g. Wire stripper
h. NEC Handbook

CLASSROOM HOURS 3

EVALUATION (RW-11)

Given appropriate tools, supplies and equipment, the student will wire a circuit with one light and a single pole switch in accordance with NEC standards.

TASK

RW-12 Wiring two lights with a single pole switch

PERFORMANCE OBJECTIVE

Diagram, identify and wire a circuit with one single pole switch and two lights.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of single pole switches
b. Types of overhead lighting
c. Wiring lights in parallel
d. Designing the circuit
e. Diagramming the circuit
f. Selection of materials
g. Wiring a single pole switch with more than one load

Provide Practical Application On:

Wire a single pole switch with two lights in parallel.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mix
b. AAVIM, Electrical Wiring

A/Vs:

a. Georgia, slide/tape, W-24, Construction Cluster, "Light with a Single Pole Switch and an Outlet That Is Always Hot"
b. Georgia, slide/tape, REW-03a and REW-03b, Residential Electrical Wiring: Secondary, "Installing Lighting Outlets"

Student Manuals:

a. Georgia, Construction Cluster, Overhead Lighting, Unit OL-2
b. Georgia, Residential Electrical Wiring: Secondary, Unit-03a
c. Georgia, Industrial Electricity, Residential Wiring, Units RW-2, RW-2a, RW-3 and RW-4a

Tools and Equipment:

(continued on back)

CLASSROOM HOURS 3

EVALUATION (RW-12)

Given appropriate tools, supplies and equipment, the student will wire a circuit with a single pole switch and two lights in accordance with NEC standards.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Single pole switches
b. Lighting boxes
c. Wires
d. Screwdriver
e. Wire strippers
f. Voltohmmeter
g. NEC Handbook

TASK

RW-13 Wiring two three-way switches

PERFORMANCE OBJECTIVE

Diagram, identify and wire two three-way switches that control one light.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of three-way switches
b. Connecting three-way switches
c. Designing a circuit for a three-way switch
d. Selection of materials
e. Wiring a three-way switch

Provide Practical Application On:

Wire a circuit with a three-way switch which controls one light.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. AAVIM, Maintaining the Lighting and Wiring System
c. AAVIM, Electrical Wiring

A/Vs:

a. Georgia, slide/tape, W-26 Construction Cluster, "Three-Way Switch"
b. Georgia, slide/tape, REW-06a, Residential Electrical Wiring: Secondary, "Installing a Three-Way Switch"

Student Manuals:

a. Georgia, Construction Cluster, Overhead Lighting, Unit OL-3
b. Georgia, Residential Electrical Wiring, Secondary, Unit REW-06
c. Georgia, Industrial Electricity, Residential Wiring, Unit RW-4

Tools and Equipment:

(continued on back)

CLASSROOM HOURS

2

EVALUATION (RW-13)

Given appropriate tools, supplies and equipment, the student will design, diagram and wire a circuit with two three-way switches which controls one light and is in accordance with NEC standards.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Three-way switch
b. Light box
c. Voltohmmeter
d. Wire
e. Wire strippers
f. Screwdriver
g. Pliers

TASK

RW-14 Wiring two three-way switches with two lights

PERFORMANCE OBJECTIVE

Design, diagram and wire a circuit with two three-way switches which controls two lights.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Identifying three-way switches
b. Wiring lights in parallel
c. Designing the circuit
d. Diagramming the circuit
e. Wiring multiple lights in parallel controlled by two three-way switches

Provide Practical Application On:

Wire two lights in parallel which are controlled by two three-way switches.

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring
b. Mullin

A/Vs:

Georgia, slide/tape, W-27, Construction Cluster, "Three-Way Switch with More Than One Light"

Student Manuals:

Georgia, Construction Cluster, Overhead Lighting, Unit OL-4

Tools and Equipment:

a. Three-way switches
b. Light boxes
c. Voltohmmeter
d. Wire
e. Wire strippers
f. Screwdrivers
g. Pliers

CLASSROOM HOURS

2

EVALUATION (RW-14)

Given appropriate tools, supplies and equipment, the student will design, diagram and wire a circuit with two lights which are controlled by two three-way switches in parallel. The circuit must be in accordance with NEC standards.

TASK

RW-15 Wiring a four-way switch controlling one light

PERFORMANCE OBJECTIVE

Diagram, identify and wire a circuit with a four-way switch and two three-way switches which controls one and two lights.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of four-way switches
b. Wiring three-way switches
c. Connecting three- and four-way switches
d. Wiring circuits in parallel
e. Designing a circuit with two three-way and one four-way switches controlling one light
f. Selection of materials
g. Wiring a circuit with two three-way switches and one four-way switch which controls one light

Provide Practical Application On:

Wire a circuit with two three-way switches and one four-way switch which controls one light.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. AAVIM, Maintaining the Wiring and Lighting System
c. AAVIM, Electrical Wiring

A/Vs:

Georgia, slide/tape, W-28, Construction Cluster, "Four-Way Switch"

Student Manuals:

a. Georgia, Construction Cluster, Overhead Lighting, Unit OL-5
b. Georgia, Industrial Electricity, Residential Wiring, Units RW-5 and RW-6

Tools and Equipment:

(continued on back)

CLASSROOM HOURS 2

EVALUATION (RW-15)

Given appropriate tools, supplies and equipment, the student will design, diagram and wire a circuit with a) one light and b) two lights controlled by one four-way switch and two three-way switches. The end product must be in accordance with NEC standards.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Three-way switches
b. Four-way switches
c. Light boxes
d. Voltohmmeter
e. Wire strippers
f. Wire
g. Screwdriver
h. Pliers

TASK

RW-16 Wiring a master switch

PERFORMANCE OBJECTIVE

Wire a circuit with a master switch and two three-way switches which control two lights.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Master switches
b. Connecting master switches
c. Designing a circuit with a master switch and two three-way switches which control two lights
d. Diagramming the circuit
e. Selection of materials
f. Wiring a master switch

Provide Practical Application On:

Wire a circuit with a master switch and two three-way switches which control two lights.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mix
b. AAVIM, Electrical Wiring

A/Vs:

Georgia, slide/tape, W-29, Construction Cluster, "Master Switch"

Student Manual:

Georgia, Construction Cluster, Overhead Lighting, Unit OL-6

Tools and Equipment:

a. Master switch
b. Three-way switches
c. Light boxes
d. Voltohmmeter
e. Wire strippers
f. Screwdriver
g. Pliers

CLASSROOM HOURS	2

EVALUATION (RW-16)

Given appropriate tools, supplies and equipment, the student will design, diagram and wire a circuit with a master switch and two three-way switches which control two lights. The circuit must be in accordance with NEC standards.

TASK

RW-17 Identifying electrical symbols

PERFORMANCE OBJECTIVE

Identify and draw the electrical symbols described in the NEC Handbook.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of electrical symbols
b. Identifying electrical symbols
c. Drawing electrical symbols
d. Scales

Provide Practical Application On:

a. Match symbols to terms.
b. Draw several specified electrical symbols.

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring
b. Mullin
c. Alerich

A/Vs:

Georgia, slide/tape, REW-12a, Residential Electrical Wiring: Secondary, "Identifying Residential Wiring Symbols and Designing Circuits"

Student Manuals:

a. Georgia, Residential Electrical Wiring: Secondary, Units REW-11 and REW-12
b. Georgia, Industrial Electricity, Residential Wiring, Unit RW-16a

Tools and Equipment:

NEC Handbook

CLASSROOM HOURS 6

EVALUATION (RW-17)

Given an overview of electrical symbols, the student will correctly identify and draw the symbols according to the instructor's requirements.

TASK

RW-18 Installing electrical symbols into a floor plan and estimating materials

PERFORMANCE OBJECTIVE

Install electrical symbols into a floor plan and estimate the materials.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of electrical symbols
b. Types of electrical fixtures
c. Types of electrical appliances
d. Identifying appropriate symbols
e. Locating and drawing symbols in correct position on floor plan
f. Estimating materials

Provide Practical Application On:

a. Using specifications, draw appropriate symbols on a floor plan.
b. Estimate materials needed for the job.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Alerich
b. Mullin
c. AAVIM, Electrical Wiring

Student Manuals:

a. Georgia, Construction Cluster, Blueprint Reading, Unit BPR-2
b. Georgia, Industrial Electricity, Residential Wiring, Unit RW-32

Tools and Equipment:

a. Floor plan
b. Specifications
c. Pencils
d. NEC Handbook

CLASSROOM HOURS

6

EVALUATION (RW-18)

Given appropriate specifications and a floor plan, the student will correctly install electrical symbols into the floor plan. The product must meet the instructor's requirements.

TASK

RW-19 Wiring light fixtures

PERFORMANCE OBJECTIVE

Wire light fixtures.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of incandescent light fixtures
b. Types of splices
c. Wiring an incandescent light fixture
d. Selection of materials
e. Testing continuity
f. Wiring the fixture
g. Safety

Provide Practical Application On:

Wire a light fixture and test for continuity.

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring
b. Alerich

A/Vs:

Georgia, slide/tape, W-37, Construction Cluster, "Wiring Fixtures"

Student Manuals:

Georgia, Construction Cluster, Lighting Fixtures, Unit LF-1

Tools and Equipment:

a. Light fixtures
b. Wire
c. Wire strippers
d. Screwdriver
e. Voltohmmeter
f. Pliers

CLASSROOM HOURS 4

EVALUATION (RW-19)

Given appropriate tools, supplies and equipment, the student will correctly wire an incandescent light fixture and test for continuity according to the instructor's requirements.

TASK

RW-20 Hanging light fixtures

PERFORMANCE OBJECTIVE

Hang a light fixture.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of light fixtures
b. Assembly of light fixtures
c. Mounting a light fixture
d. Selection of materials
e. Hanging a fixture

Provide Practical Application On:

Hang a light fixture

INSTRUCTIONAL MATERIALS

Textbooks:

AAVIM, *Electrical Wiring*

A/Vs:

Georgia, slide/tape, W-38, Construction Cluster, "Hanging Fixtures"

Student Manuals:

Georgia, *Construction Cluster, Lighting Fixtures*, Unit LF-2

Tools and Equipment:

a. Light fixture and hardware
b. Wire nuts
c. Pliers
d. Wrenches
e. Tape measure
f. Screwdrivers
g. Wire strippers

CLASSROOM HOURS

3

EVALUATION (RW-20)

Given a light fixture and hanging hardware, the student will correctly hang the light fixture according to the instructor's requirements.

TASK

RW-21 Identifying principles and applications of transformers

PERFORMANCE OBJECTIVE

Identify principles and applications of transformers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformers
b. Step-down and step-up transformers
c. Current in transformer indirectly proportioned to voltage ratio
d. Power in primary and power in secondary
e. Schematic for a transformer
f. Electro-magnetic induction
g. Turn ratio
h. Voltage ratio
i. Calculating formulas
j. True power vs. apparent power
k. Transformer efficiency

Provide Practical Application On:

Work problems using formulas for the following:

1. Power
2. Turns
3. Volts
4. Current

INSTRUCTIONAL MATERIALS

Textbooks:

a. Alerich
b. Mullin

Student Manuals:

Georgia, Industrial Electricity, Residential Wiring, Units RW-27a and RW-27a-1

CLASSROOM HOURS

5

EVALUATION (RW-21)

Given required formulas and data, the student will calculate ratios for power, turns, volts and current for a transformer according to the manufacturer's specifications.

TASK

RW-22 Wiring a low voltage transformers

PERFORMANCE OBJECTIVE

Wire a low voltage transformer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of low voltage transformers
b. How a transformer operates
c. Determining transformer voltage
d. Location of transformer
e. How to connect a low voltage transformer
f. Testing the transformer

Provide Practical Application On:

Install wire and test a low voltage transformer.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. AAVIM, Electrical Wiring

A/Vs:

Georgia, slide/tape, W-39, Construction Cluster, "Transformers"

Student Manuals:

Georgia, Construction Cluster, Low Voltage, Unit LV-1

Tools and Equipment:

a. Low voltage transformer
b. Voltohmmeter
c. Screwdrivers
d. Tape measures
e. Wire nuts
f. Cable
g. Pliers
h. Wire strippers

CLASSROOM HOURS 3

EVALUATION (RW-22)

Given appropriate tools, supplies and equipment, the student will correctly locate, install and wire a low voltage transformer. Installation and wiring must meet instructor's requirements.

TASK

RW-23 Installing a push button switch

PERFORMANCE OBJECTIVE

Install a push button switch for a doorbell circuit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of low voltage switches
b. How a low voltage switch operates
c. Installing a push button switch

Provide Demonstration On:

Mounting a doorbell switch

Provide Practical Application On:

Insall a low voltage push button switch.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. Mix
c. AAVIM, Electrical Wiring

A/Vs:

Georgia, slide/tape, W-40, Construction Cluster, "Push Button Switches"

Student Manuals:

Georgia, Construction Cluster, Low Voltage, Unit LV-2

Tools and Equipment:

a. Doorbell switch
b. Wire
c. Screwdriver
d. Wire stripper
e. Saw
f. Tape measure
g. Voltohmmeter
h. Hammer
i. Chisel

CLASSROOM HOURS

2

EVALUATION (RW-23)

Given appropriate tools, supplies and equipment, the student will correctly install and wire a low voltage push button switch and test the switch. Installation and wiring must meet instructor's requirements.

TASK

RW-24 Installing bells and chimes

PERFORMANCE OBJECTIVE

Install a doorbell circuit with either bells or chimes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of bells and chimes
b. Installing bells and chimes and connecting them to low voltage push button switch and transformer
c. Installing the low voltage, push button switch
d. Installing the low voltage transformer

Provide Practical Application On:

Install a doorbell circuit using either bells or chimes.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. Mix
c. AAVIM, Electrical Wiring

A/Vs:

a. Georgia, slide/tape, W-41, Construction Cluster, "Bells and Chimes"
b. Georgia, slide/tape, REW-05a, Residential Electrical Wiring: Secondary, "Installing a Door Bell Circuit"

Student Manuals:

a. Georgia, Construction Cluster, Low Voltage, Unit LV-3
b. Georgia, Residential Electrical Wiring: Secondary, Unit REW-05
c. Georgia, Industrial Electricity, Residential Wiring, Unit RW-23

Tools and Equipment:

(continued on back)

CLASSROOM HOURS

2

EVALUATION (RW-24)

Given appropriate tools, supplies and equipment, the student will install a doorbell circuit using either bells or chimes. Installation must meet instructor's requirements.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

a. Low voltage push button switch
b. Transformer
c. Cable
d. Bells or chimes
e. Screwdriver
f. Tape measure
g. Wire nuts
h. Voltohmmeter
i. Wire
j. Chisel
k. Wire stripper
l. Saw
m. Hammer

TASK

RW-25 Wiring special low voltage circuits

PERFORMANCE OBJECTIVE

Wire special voltage circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wiring intercom systems
b. Wiring burglar alarm systems
c. Installing low voltage remote control lighting system
d. Installing low volgate wire

Provide Practical Application On:

a. Wire an intercom system.
b. Wire an open circuit burglar alarm system.
c. Wire a remote control lighting system.

INSTRUCTIONAL MATERIALS

Textbooks:

Alerich

Student Manuals:

Georgia, Industrial Electricity, Residential Wiring, Units RW-24, RW-25 and RW-26

Tools and Equipment:

a. Tool kit
b. Intercom system kit
c. Burglar alarm system kit
d. Remote control lighting system kit
e. Voltohmmeter

CLASSROOM HOURS 2

EVALUATION (RW-25)

Given appropriate tools, supplies and equipment, the student will install an intercom system, a burglar alarm system and a remote control low voltage lighting system according to manufacturer's specifications.

TASK

RW-26 Connecting 220v grounded outlets

PERFORMANCE OBJECTIVE

Wire and connect a 220 volt grounded outlet in the entrance switch box.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. 220 volt grounded outlets
b. Utility box installation
c. Types of wires
d. Pulling wires
e. Types of entrance switches
f. Testing with VOM

Provide Demonstration On:

Installing a utility box

Provide Practical Application On:

Wire a 220v outlet.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. AAVIM, Electrical Wiring

A/Vs:

a. Georgia, slide/tape, W-19, Construction Cluster, "220 Volt Grounded Outlets"
b. Georgia, slide/tape, REW-07a, Residential Electrical Wiring: Secondary, "Installing 230v Circuits and Outlets"

Student Manuals:

a. Georgia, Construction Cluster, Grounded Outlets, Unit GC-1
b. Georgia, Residential Electrical Wiring: Secondary, Unit REW-07

Tools and Equipment:

a. 220v receptacle
b. Wire
c. Voltohmmeter

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CLASSROOM HOURS

3

EVALUATION (RW-26)

Given appropriate tools, supplies and equipment, the student will correctly wire a 220 volt receptacle according to NEC specifications.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. Wire strippers
e. Pliers
f. Wire nuts
g. Fast tape
h. NEC Handbook

TASK

RW-27 Wiring a hot water heater

PERFORMANCE OBJECTIVE

Wire a 220 volt hot water heater.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of electric hot water heaters
b. Wiring electrical connections for a hot water heater
c. Wiring entrance switch
d. Wiring the hot water heater
e. Safety

Provide Demonstration On:

Making connections on an electric hot water heater

Provide Practical Applications On:

a. Wire an entrance switch.
b. Wire a hot water heater.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. AAVIM, Electrical Wiring
c. NEC Handbook

A/Vs:

Georgia, slide/tape, W-20, Construction Cluster, "Electric Hot Water Heater"

Student Manuals:

a. Georgia, Construction Cluster, Grounded Outlets, Unit GC-2
b. Georgia, Industrial Electricity, Residential Wiring, Units RW-14 and RW-22

Tools and Equipment:

a. Hot water heater
b. Cable
c. Wire strippers
d. Screwdriver
e. Pliers

CLASSROOM HOURS

2

EVALUATION (RW-27)

Given appropriate tools, supplies and equipment, the student will wire a hot water heater according to NEC specifications.

TASK

RW-28 Wiring a range

PERFORMANCE OBJECTIVE

Wire a range or junction box.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of ranges
b. Types of wire
c. Types of boxes
d. How to connect a range
e. How to connect a junction box
f. Selection of materials

Provide Practical Application On:

Wire a range or a junction box.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. AAVIM, Electrical Wiring

A/Vs:

a. Georgia, slide/tape, W-21, Construction Cluster, "Ranges"
b. Georgia, slide/tape, MA-01a, Major Applicances: Secondary, "Installing Electric Range"

Student Manuals:

a. Georgia, Construction Cluster, Grounded Outlets, Unit GC-3
b. Georgia, Industrial Electricity, Residential Wiring, Units RW-16 and RW-17

Tools and Equipment:

a. Range
b. Junction box
c. Screwdrivers

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CLASSROOM HOURS	2

EVALUATION (RW-28)

Given appropriate tools, supplies and equipment, the student will correctly wire a range according to NEC standards.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. Wire strippers
e. Wire
f. Voltohmmeter
g. NEC Handbook
h. Pliers

TASK

RW-29 Wiring baseboard-type wall heaters

PERFORMANCE OBJECTIVE

Wire baseboard-type wall heaters for both 110 volts and 220 volts.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Identifying special purpose outlets
b. Grounding type receptacles
c. Calculating the load for a special purpose outlet and designing circuits
d. Making proper grounding connections
e. Using armored cable and non-metallic sheathed cable
f. Grounding provisions on heater units
g. Testing for grounding continuity between grounded outlet box and grounding circuit receptacle

Provide Demonstration On:

Wiring circuits for grounding type receptacles

Provide Practical Application On:

Wire a grounding type receptacle for a baseboard-type heater unit.

INSTRUCTIONAL MATERIALS

Textbooks:

Mullin

A/Vs:

Georgia, slide/tape, W-30, Construction Cluster, "Wall Heaters"

Student Manuals:

a. Georgia, Construction Cluster, Electric Heaters, Unit EH-1
b. Georgia, Industrial Electricity, Residential Wiring, Unit RW-18

Tools and Equipment:

a. Grounding type receptacle
b. Conductors
c. Wire strippers

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CLASSROOM HOURS 3

EVALUATION (RW-29)

Given appropraite tools, supplies and equipment, the student will wire a grounding type receptacle for a baseboard-type heater unit and test for continuity. The task must be completed according tto the instructor's specifications.

INSTRUCTIONAL MATERIALS

Tools and Eqiupment:

d. Screwdrivers
e. Voltohmmeter
f. Heater
g. Pliers

TASK

RW-30 Installing a 230v central heating and cooling circuit and disconnect

PERFORMANCE OBJECTIVE

Install a 230 volt central heating or cooling circuit and disconnect.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Maximum loads for motor operated and combination loads
b. Calculating load and determining wire size for a heating and cooling system
c. Exceptions to maximum load for heating units
d. Disconnecting means for heater
e. Supplementary over-current protectors
f. Marking of heating and air conditioning equipment
g. Installing a 230v window A/C unit

INSTRUCTIONAL MATERIALS

Textbooks:

a. *NEC Handbook*
b. AAVIM, *Electrical Wiring*

Student Manuals:

Georgia, *Industrial Electricity*, *Residential Wiring*, Units RW-19 and RW-20

Tools and Equipment:

a. Wire
b. Fused disconnect
c. Breakers
d. Voltohmmeter
e. Wire strippers
f. Screwdriver
g. Wire nuts
h. Pliers

CLASSROOM HOURS 3

EVALUATION (RW-30)

Given the electrical specifications for a heating system, the student will be able to calculate the load and determine wire size and overcurrent protection requirements to wire a heater and disconnect. The completed task must be in accordance with NEC specifications.

TASK

RW-31 Calculating loads

PERFORMANCE OBJECTIVE

Calculate range, heating and total load for a residence.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Review NEC article 220
b. Calculating range load
c. Calculating heating and cooling loads
d. Calculating fixed appliance load
e. Small appliance branch circuit loads
f. Total load calculation
g. Writing service entrance and branch circuit specification for a residence from a blueprint

Provide Practical Application On:

a. Calculate total load for a residence.
b. Write specification for service entrance and brand circuits from a blueprint.

INSTRUCTIONAL MATERIALS

Textbooks:

a. NEC Handbook
b. AAVIM, Electrical Wiring

Student Manuals:

Georgia, Industrial Electricity, Residential Wiring, Units RW-13a, RW-13a-1 and RW-28

Tools and Equipment:

Blueprints of residence

CLASSROOM HOURS 3

EVALUATION (RW-31)

Given total dimensions for a residence and small appliance, heating, cooling and range load for the residence, the student will calculate the total load for the residence according to the instructor's requirements.

TASK

RW-32 Calculating wire size and voltage drop

PERFORMANCE OBJECTIVE

Calculate wire size and voltage drop.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Insulation requirements
b. Properties of conduction
c. Mechanical strength of conductors
d. Three-wire single phase residential service
e. Type MC cable
f. Bare conductors
g. Mineral-insulated mineral-sheathed cable
h. Type MTW machine tool wire
i. More than three conductors in a raceway or cable
j. Overcurrent protection
k. Neutral conductor
l. Grounding conductor
m. Voltage drop factors
n. Wire size factors
o. Formula
p. Power loss

INSTRUCTIONAL MATERIALS

Textbooks:

a. NEC Handbook
b. AAVIM, Electrical Wiring
c. Alerich

Student Manuals:

Georgia, Industrial Electricity, Residential Wiring, Units RW-13b and RW-20a

CLASSROOM HOURS	3

EVALUATION (RW-32)

Given appropriate NEC data for allowable ampacities and properties of conductors, the student will calculate wire size and voltage drop requirements for a given circuit. The calcuations must meet the instructor's satisfaction.

TASK

RW-33 Making calculations for three-wire branch circuits

PERFORMANCE OBJECTIVE

Make calculations for three-wire branch circuit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Phase (define)
b. Alternating current
c. Comparing voltage to time
d. Comparing voltage to voltage
e. Out-of-phase voltage
f. Common three-wire branch circuits
g. Balanced system
h. Over-loaded neutral
i. Procedure for connecting a three-wire circuit

Provide Practical Application On:

Make calculations necessary for designing a three-wire circuit.

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring
b. Mullin
c. NEC Handbook

Student Manuals:

a. Georgia, Industrial Electricity, Residential Wiring, Unit RW-10a
b. Georgia, Industrial Electricity, NEC Handbook, Unit NEC-4

CLASSROOM HOURS 3

EVALUATION (RW-33)

Given appropriate formulas and procedures, the student will make all necessary calculations for three-wire circuits according to the instructor's requirements.

TASK

RW-34 Selecting conduit for service entrance

PERFORMANCE OBJECTIVE

Determine the proper size and type of conduit for an ordinary service entrance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of conduit
b. Uses of conduit
c. Mounting service entrance conduit
d. Identifying service entrance supporting
e. Bending conduit (thin wall)
f. Measuring thin wall conduit
g. Bending thin wall conduit
h. Connecting thin wall conduit
i. Threading thin wall conduit
j. Connecting ridid conduit
k. Installing rigid conduit supporting
l. Safety

Provide Practical Application On:

Mounting service entrance conduit

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring
b. Mullin

A/Vs:

a. Georgia, slide/tape, REW-08b, Residential Electrical Wiring: Secondary, "Installing Service Entrance"
b. Georgia, slide/tape, W-4, W-33, W-34, W-35 and W-36, Construction Cluster, "Mast", "Service Entrance Conduit", "Thinwall Conduit", "Rigid Conduit" and "Supporting Conduit"

Student Manuals:

a. Georgia, Construction Cluster, Temporary Entrance, Unit TE-4
b. Georgia, Construction Cluster, Units C-1, C-4

Tools and Equipment:

a. Conduit
b. Mounting hardware
c. Conduit (tubing) bender
d. Drill
e. Screwdriver
f. Pliers

CLASSROOM HOURS

2

EVALUATION (RW-34)

Given appropriate tools, supplies and equipment, the student will select the proper size conduit and observe proper mounting. Procedures and all safety precautions must meet the instructor's satisfaction.

TASK

RW-35 Installing an electrical service entrance for single-phase power

PERFORMANCE OBJECTIVE

Install an electrical service entrance for single-phase power.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Locating the service entrance
b. Identifying meter bases
c. Installing a meter base
d. Laying out and drilling holes for service entrance
e. Identifying and installing masts
f. Identifying and installing roof boots
g. Identifying sizes and types of conductors
h. Selecting conductors
i. Pulling conductors
j. Installing a weather-head
k. Methods of grounding
l. Coordinating installation with local power company
m. Drip loops
n. Fuse box and connections
o. Safety

Provide Practical Application On:

Install an electrical service entrance for single-phase power.

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring
b. Mullin
c. Alerich
d. Mix

A/Vs:

a. Georgia, slide/tape, REW-08a, REW-08b and REW-08c, Residential Electrical Wiring: Secondary, "Installing Service Entrance"
b. Georgia, slide/tape, W-1, W-12, W-14, W-15, W-16 and W-18, Construction Cluster, "Power Outlet Box", "Layout of the Service Entrance", "Roof Boots", "Conductors", "Fish Tapes" and "Grounding"

Student Manuals:

a. Georgia, Construction Cluster, Service Entrance, Units SE-1 through SE-9

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CLASSROOM HOURS 4

EVALUATION (RW-35)

Given appropriate tools, supplies and equipment, the student will install an electrical service entrance for single-phase power according to NEC standards.

INSTRUCTIONAL MATERIALS

Student Manuals:

b. Georgia, Residential Electrical Wiring: Secondary, Unit REW-08
c. Georgia, Industrial Electricity, Residential Wiring, Unit RW-30

Tools and Equipment:

a. Basic electrician's tools
b. Conductor
c. Conduit
d. Weatherhead
e. Bushings
f. Meter base
g. C.B.

TASK

RW-36 Installing a circuit breaker box (or fuse box)

PERFORMANCE OBJECTIVE

Install a circuit breaker box or fuse box.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of circuit breaker boxes
b. Locating the box
c. Installing the box
d. Pulling conductors
e. Types of breakers
f. Installing breakers
g. Types of fuses
h. Installing a fuse box
i. Installing wiring and fuse or breaker for an electric furnace
j. Wiring thermostats

Provide Practical Application On:

Mount a circuit breaker, box and install breakers.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. AAVIM, Maintaining the Wiring and Lighting System
c. AAVIM, Electrical Wiring
d. NEC Handbook

A/Vs:

a. Georgia, slide/tape, W-8, W-9, W-31 and W-32, Construction Cluster, "Circuit Breakers", "Fuses", "Electric Furnances" and "Thermostats"
b. Georgia, slide/tape, REW-09a, REW-09b, REW-09c and REW-09d, Residential Electrical Wiring: Secondary, "Install Main Panel"

Student Manuals:

a. Georgia, Construction Cluster, Service Entrance Switch, Units SES-1 and SES-2
b. Georgia, Industrial Electricity, Residential Wiring, Unit RW-29

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CLASSROOM HOURS 3

EVALUATION (RW-36)

Given appropriate tools, supplies and equipment, the student will locate and install a circuit breaker for 115 volt and 230 volt applications. The installation must be in accordance with NEC standards.

INSTRUCTIONAL MATERIALS

Student Manuals:

c. Georgia, Residential Electrical Wiring: Secondary, Unit REW-09
d. Georgia, Construction Cluster, Electric Heaters, Unit EH-2 and EH-3

Tools and Equipment:

a. Distribution panel on fusebox
b. Breakers or fuses
c. Screwdrivers
d. Wire strippers
e. Voltohmmeter
f. Tape measure

TASK

RW-37 Wiring a switch box

PERFORMANCE OBJECTIVE

Wire a service switch box.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of conductors
b. Sizes of conductors
c. NEC regulations for conductor size and type
d. Selection of appropriate size breaker
e. Terminal connections
f. Safety

Provide Practical Application On:

Wire a service switch box and install the appropriate size breaker.

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Electrical Wiring
b. Mullin
c. NEC Handbook

A/Vs:

Georgia, slide/tape, W-10, Construction Cluster, "Service Entrance Wiring"

Student Manuals:

Georgia, Construction Cluster, Service Entrance Switch, Unit SES-3

Tools and Equipment:

a. Switch box
b. Breakers
c. Screwdrivers
d. Wire strippers
e. Voltohmmeter

CLASSROOM HOURS

3

EVALUATION (RW-37)

Given appropriate tools, supplies and equipment, the student will wire a service switch box according to NEC standards.

TASK

RW-38 Installing ground fault interruptors

PERFORMANCE OBJECTIVE

Install a ground fault interruptor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of ground fault interruptors
b. Uses of the ground fault interruptor
c. How the ground fault interruptor works
d. Installing the ground fault
e. Effects of current and safety

Provide Practical Application On:

Install a ground fault interruptor.

INSTRUCTIONAL MATERIALS

Textbooks:

a. AAVIM, Maintaining the Lighting and Wiring System
b. AAVIM, Electrical Wiring

A/Vs:

Georgia, slide/tape, W-7, Construction Cluster, "Ground Fault Interruptor"

Student Manuals:

a. Georgia, Construction Cluster, Temporary Entrance, Unit TE-7
b. Georgia, Industrial Electricity, Residential Wiring, Unit RW-11a

Tools and Equipment:

a. Distribution panel
b. Ground fault interruptor
c. Wire stripper

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CLASSROOM HOURS 3

EVALUATION (RW-38)

Given appropriate tools, supplies and equipment, the student will correctly install a ground fault interruptor according to the instructor's satisfaction.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. Screwdriver
e. Pliers
f. Voltohmmeter

TASK

RW-39 Installing a temporary service entrance

PERFORMANCE OBJECTIVE

Install a temporary service entrance.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Identifying and installing power outlet box
b. Identifying and installing power cutoff
c. Determining meter base size and installing meter base
d. Estimating mast size
e. Installing mast conduit
f. Assembling and installing weatherhead
g. Safety

Provide Practical Application On:

Install power outlet box, cutoff, meter base, mast, weatherhead and wire a temporary service entrance.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Mullin
b. AAVIM, Electrical Wiring
c. AAVIM, Maintaining the Lighting and Wiring System
d. NEC Handbook

A/Vs:

a. Georgia, slide/tape, W-1 through W-7, Construction Cluster, "Power Outlet Box", "Power Cutoff", "Meter Bases", "Mast", "Weatherheads", "Wire Sizes" and "Ground Fault Interruptor"
b. Georgia, Slide/tape, REW-10a, Residential Electrical Wiring: Secondary, "Temporary Service"

Student Manuals:

a. Georgia, Construction Cluster, Temporary Entrance, Units TE-1 through TE-7

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CLASSROOM HOURS 5

EVALUATION (RW-39)

Given appropriate tools, supplies and equipment, the student will install and wire a temporary service entrance according to NEC standards.

INSTRUCTIONAL MATERIALS

Student Manuals:

b. Georgia, Residential Electrical Wiring: Secondary, Unit REW-10

Tools and Equipment:

a. Power outlet box
b. Power cutoff
c. Meter base
d. Weatherhead
e. Mast
f. Wire
g. Wire strippers
h. Pliers
i. Voltohmmeter
j. Screwdrivers

TASK

T-01 Determining transformer polarity

PERFORMANCE OBJECTIVE

Test and identify the leads of transformers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformers
b. Polarity of transformers
c. Test for polarity
d. Transformer operation
e. Lead identification and numbering
f. Primary
g. Secondary

Provide Demonstration On:

a. Testing of transformers
b. Lead identification and numbering

Provide Practical Application On:

a. Polarity testing of transformer
b. Test for transformer
c. Lead identification and numbering
d. Operation of transformers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duff
b. Westinghouse

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #802, "Basic Electricity and Electronics Explained-Alternating Current"

Tools and Equipment:

a. Shop tools
b. Small one phase transformer
c. VOM
d. D/C power supply
e. Single pole switch

CLASSROOM HOURS

30

EVALUATION (T-01)

Given a 24 volt 40VA single phase transformer and the necessary test equipment, the student will determine the polarity of the transformer and correctly identify and tag the terminals.

TASK

T-02 Connecting to and operating dual voltage single phase transformers

PERFORMANCE OBJECTIVE

Hook-up and operation of dual voltage single phase transformer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Dual voltage transformer
b. Lead identification
c. Operation low volts (Parallel)
d. Operation high volts (Series)
e. Induction
f. Primary and Secondary
g. Ratio

Provide Demonstration On:

a. Dual voltage transformer
b. Lead connection (high and low volts)

Provide Practical Application On:

a. Dual voltage transformer
b. Operation (series and parallel)
c. Lead connection
d. Line connection
e. Output secondary
f. Ratio

INSTRUCTIONAL MATERIALS

Textbooks:

a. Dunlap-Siefert-Austin
b. Duff

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #833, "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning-Part One"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. VOM
c. Dual volt single phase transformer
d. Power supply 460/230
e. Wire nuts

CLASSROOM HOURS 15

EVALUATION (T-02)

Given a one phase dual voltage transformer 460/230v, the necessary test equipment and power supplies, the student accurately make the correct wiring connection for 460/230v operation, check and record all voltage readings. Secondly, the student will make the correct wiring connection for 230/115v operation, check and record all voltage readings. All connections and wiring must meet manufacturer's instruction and local and national code standards.

TASK

T-03 Connecting single phase transformers in series

PERFORMANCE OBJECTIVE

Connect two single phase transformers for series operation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformer in series
b. KVA rating
c. Voltage output
d. Current output
e. Series connection of transformer
f. Compatibility of transformers
g. Dual volts operation

Provide Demonstration On:

Series operation of transformer

Provide Practical Application On:

a. Transformers operating in series
b. KVA rating
c. Connecting transformers in Series (low and high volts)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Duff
c. Dunlap-Siefort-Austin

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #833, "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning-Part One"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. VOM
c. Two single phase dual volt transformers
d. Power supplies
e. Wire nuts

CLASSROOM HOURS 15

EVALUATION (T-03)

Given two single phase dual voltage transformers and the necessary test equipment and power supplies, the student will: (1) complete the required test to determine the compatibility of the transformers; (2) make the correct wiring connections for series operation of the transformers for operation from high and low voltage lines; and (3) check and record all voltage reading. All connections and wiring must meet manufacturer's instruction, local and national code standards.

TASK

T-04 Connecting single phase transformers in-parallel

PERFORMANCE OBJECTIVE

Correctly connect two single phase transformers for parallel operation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformers in parallel
b. KVA rating
c. Voltage output
d. Current output
e. Parallel connection of transformers
f. Compatibility of transformers
g. Low volts operation

Provide Demonstration On:

Parallel operation of transformer

Provide Practical Application On:

a. Transformers operating in parallel
b. KVA rating
c. Connections of transformers (low and high volts)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Duff
c. Dunlap-Siefert-Austin

A/Vs:

Bergwall Production, Inc., filmstrips/cassettes, #s 833 and 834, "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning-Parts One and Two"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. VOM
c. Two single phase transformers (dual volts)
d. Power supplies
e. Wire nuts

CLASSROOM HOURS

20

EVALUATION (T-04)

Given two single phase dual voltage transformers and the necessary test equipment and power supplies, the student will: (1) make the correct wiring connections for parallel operation of the transformers from high and low voltage lines; and (2) check and record all voltage readings. All connections must meet manufacturer's instructions, all local and national code standards.

TASK

T-05 Determing the KVA rating of transformers-single phase

PERFORMANCE OBJECTIVE

Determine the KVA rating of a transformer to operate a two horsepower single phase motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Single phase Induction motors 230v
b. KVA calculations one phase
c. Motor lead connection
d. Transformer ratings one phase
e. Transformer selection one phase
f. Transformer installation
g. Transformer connections
h. Step up/step down

Provide Demonstration On:

a. Motor hook-up
b. KVA of transformer

Provide Practical Application On:

a. Transformer installation
b. Motor operation
c. Motor installation.
d. Transformer hook-up
e. Transformer sizing

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Duff
c. Manufacturer's Catalog
d. Dunlap-Siefert-Austin

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #s 833 and 834, "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning-Parts One and Two"

Tools and Equipment:

a. One phase motor
b. Transformer
c. Power supply
d. Shop tools
e. VOM

CLASSROOM HOURS 10

EVALUATION (T-05)

Given a two horsepower 230v one phase induction motor and the necessary test equipment and power supplies, the student will: (1) complete the necessary calculations to determine the KVA rating of a one phase transformer for operation of the motor from a 460v one phase line; (2) select, install, and correct the transformer; and (3) connect and operate the motor from the secondary of the transformer. All work must meet local and national code standards and manufacturer's instructions for transformer installation.

TASK

T-06 Determining the KVA rating of transformers-three phase

PERFORMANCE OBJECTIVE

Determine the KVA rating of a transformer to operate a two horse power three phase motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Three phase - power
b. Three phase induction motor 230 volts
c. KVA calculation three phase
d. Motor lead connection
e. Motor operation
f. Transformer ratings three phase
g. Transformer three phase
h. Transformer one phase bank
i. Transformer installation
j. Transformer connections
k. Step up/step down

Provide Demonstration On:

a. Motor hook-up
b. Three phase transformer hook-up
c. One phase transformer bank hook-up

Provide Practical Application On:

a. Three phase motor operation
b. Three phase motor hook-up
c. Three phase transformer operation and installation
d. Three phase transformer hook-up
e. One phase transformer banks
f. Three phase power

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Dunlap-Siefert-Austin
c. Duff
d. Manufacturer's catalog

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #s 833 and 834, "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning-Parts One and Two"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Three phase motor
b. Three phase transformer
c. Shop tools
d. VOM
e. Power supply
f. A/C amp meter

CLASSROOM HOURS 10

EVALUATION (T-06)

Given a two horsepower 230v three phase induction and the necessary test equipment and power supplies, the student will: (1) complete the necessary calculations to determine the KVA rating of a three phase transformer bank for operation of the motor from a 460v three phase lines; (2) select, install, and connect the transformer bank; and (3) connect and operate the motor from the secondary of the transformer. All work must meet local and national code standards and manufacturer's instruction for transformer installation.

TASK

T-07 Hooking-up and operating a one phase auto transformer

PERFORMANCE OBJECTIVE

Hook-up and operate a one phase auto transformer 208/230.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Auto transformer
b. Operation of an auto transformer
c. Application
d. Transformer taps
e. Lead numbers
f. Lead connections
g. Ratio
h. Polarity

Provide Demonstration On:

a. Auto transformer operation
b. Transformer connection

Provide Practical Application On:

a. Auto transformer connection
b. Primary and secondary
c. Applications

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Dunlap-Siefert-Austin
c. Duff

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. Auto transformer or one phase transformer
c. VOM
d. Power supply
e. A/C amp meter

CLASSROOM HOURS 10

EVALUATION (T-07)

Given a one phase 230/208v auto-transformer and the necessary test equipment and power supplies, the student will: (1) make the correct wiring connections for 208 to 230 volt operation; (2) check and record all voltage readings; (3) make the correct wiring connections for 230 to 208 operation; (4) check and record all voltage readings; and (5) make sure the correct wiring connections for 230 to 208 meet local and national code standards, and manufacturer's instructions for transformer installation.

TASK

T-08 Hooking up a one phase buck booster transformer

PERFORMANCE OBJECTIVE

Hook-up, operate and test a one phase buck booster transformer 208/318 volts.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Buck booster transformer
b. Operation of buck booster transformer
c. Lead connection
d. Ratio
e. Polarity

Provide Demonstration On:

a. Buck booster transformer
b. Buck booster transformer connection

Provide Practical Information On:

a. Buck booster transformer operation
b. Buck booster transformer connection

INSTRUCTIONAL MATERIALS

Textbooks:

a. Dunlap-Siefert-Austin
b. Croft-Carr-Watt

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. One phase booster transformer
c. VOM
d. Power supply

CLASSROOM HOURS 10

EVALUATION (T-08)

Given a single phase transformer, the necessary test equipment, and power supplies, the student will: (1) make the wiring connection and operate a one phase booster transformer 208/318v; and (2) check and record all voltage readings. All wiring must meet local and national codes standards, and manufacturer's instructions for transformer installation.

TASK

T-09 Hooking up a three phase booster transformer

PERFORMANCE OBJECTIVE

Hook-up, test and operate a three phase booster transformer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Three phase power
b. Three phase booster transformer
c. Polarity
d. Operation of booster
e. Applications
f. Connection (primary and secondary)
g. KVA rating
h. Ratio

Provide Demonstration On:

a. Three phase transformer
b. Three phase booster connection

Provide Practical Application On:

a. Three phase power
b. Three phase operation
c. Three phase booster connection (primary and secondary)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Dunlap-Siefert-Austin

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. VOM
c. Three phase booster or three phase transformer
d. Power supply

CLASSROOM HOURS

10

EVALUATION (T-09)

Given three single phase transformers, the necessary test equipment, and power supplies, the student will: (1) make the proper wiring connections and operate a three phase booster transformer 208/312; and (2) check out and record all voltage readings. All wiring must meet local and national code standards, and manufacturer's instructions for transformer installation.

TASK

T-10 Hooking up a three phase auto transformer

PERFORMANCE OBJECTIVE

Hook-up, test and operate a three phase auto transformer bank.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Auto transformer three phase
b. Ratio
c. Lead marking
d. Operation
e. Application
f. Wye connection
g. Delta connection

Provide Demonstration On:

a. Application
b. Lead connection of three phase auto transformer
c. Wye connection
d. Delta connection
e. Three phase auto transformer operation
f. Wye connection of auto transformer
g. Delta connection of auto transformer
h. Connections line and load

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Duff
c. Dunlap-Siefert-Austin

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. Three one phase transformer
c. VOM
d. Power supply

CLASSROOM HOURS 10

EVALUATION (T-10)

a. Given three one phase three KVA dual voltage transformers, the necessary test equipment, and power supplies, the student will: (1) make the wiring connections and operate a three phase auto transformer bank 208/104 volts; and (2) check and record all voltages readings. All wiring must meet local and national code standards, and manufacturer's instructions for installation.

b. Given three one phase three KVA dual voltage transformers, the necessary test equipment and power supplies, the student will: (1) make the wiring connections and operate a three phase Wye connect auto transformer bank and three phase Delta connected auto transformer bank; and (2) check and record all voltage readings. All wiring must meet local and national code standards, and manufacturer's instructions for transformer installation.

TASK

T-11 Hooking up a three phase transformer bank; Wye/Wye

PERFORMANCE OBJECTIVE

Hook-up, operate and test a three phase transformer bank Wye/Wye.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformer operation
b. Wye connection (3 wire, 4 wire)
c. Primary winding connection
d. Ratio
e. Applications

Provide Demonstration On:

a. Wye connection three and four wire
b. Three phase loads
c. One phase loads
d. Balance of loads
e. Neutral loads

Provide Practical Application On:

a. Wye transformer connection
b. High volts three and four wire
c. Low volts three and four wire
d. Three phase loads operation
e. One phase loads operation
f. Neutral loads

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duff
b. Dunlap-Siefert-Austin

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. Dual volts transformers (3)
c. VOM
d. Power supplies
e. Resistive load banks
f. A/C amp meter

CLASSROOM HOURS 30

EVALUATION (T-11)

a. Given three one phase three KVA dual voltage transformers, the necessary test equipment and power supplies, the student will: (1) make the wiring connections and operate a three phase bank connected Wye-Wye; (2) operate at high and low volts three phase three wire and three phase four wire; and (3) check and record all voltage readings. All wiring must meet local and national codes standards and manufacturer's instruction for transformer installation.

b. The student will test the above with a balanced resistive load.

c. The student will test the above with an unbalanced resistive load.

TASK

T-12 Hooking up a three phase transformer bank; Delta/Delta

PERFORMANCE OBJECTIVE

Hook-up, operate and test a three phase transformer bank connected Delta/Delta.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Isolated
b. Grounded
c. Point of grounded connection
d. Red lead
e. Ratio
f. Step up/step down
g. Current one voltage in a Delta connection
h. Voltage to ground
i. Applications
j. Load balance three phase
k. Single phase loads

Provide Demonstration On:

a. Delta/Delta operation
b. 3 and 4 wire secondary
c. Loads from secondary
d. Balanced loads

Provide Practical Application On:

a. Delta connected transformers
b. Wiring connections
c. Low and high volts operation
d. Balance loads
e. 3 and 4 wire secondary connections
f. Neutral loads
g. Isolated transformer
h. Grounded transformer
i. Three phase loads from secondary
j. One phase loads from secondary

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duff
b. Dunlap-Siefert-Austin

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Three dual volt
b. Shop tools
c. VOM
d. A/C amp meter
e. Resistive load banks

CLASSROOM HOURS 30

EVALUATION (T-12)

Given three one phase three KVA dual voltage transformers, the necessary test equipment and power supplies, the student will: (1) make the wiring connections and operate a three phase bank connected Delta-Delta; (2) operate at high and low volts three phase three wire and three phase four wire; and (3) check and record all voltage readings. All wiring must meet local and national code standards, and manufacturer's instructions for installation.

TASK

T-13 Hooking up a three phase bank of transformers; open Delta

PERFORMANCE OBJECTIVE

Hook-up, operate and test a three phase bank of transformers open Delta.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Open Delta
b. 3 phase using 2 single phase transformers
c. Load capability
d. Grounded
e. Isolated
f. Point of grounding
g. Red lead
h. Load balance
i. Single phase loads
j. Ratio
k. Step up/step down

Provide Demonstration On:

a. Open Delta Operation
b. Load capability
c. Grounding
d. High leg (red lead)
e. Load balance

Provide Practical Application On:

a. Hook up transformers 3 and 4 wire
b. 3 phase loads
c. Load balance
d. Point of grounding
e. Load capability

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duff
b. Dunlap-Siefert-Austin

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. 2 single phase dual volt transformers
c. VOM
d. A/C amp meter
e. e phase loads
f. 1 phase loads

CLASSROOM HOURS 20

EVALUATION (T-13)

Given two one phase transformers, dual voltage transformer, the necessary test equipment and power supplies, the student will: (1) make the wiring connections and operate a three phase bank connected open-Delta; (2) operate at high and low volts three phase three wire and three phase four wire; and (3) check and record all voltage readings. All wiring and connections must meet local and national code standards and manufacturer's instructions for installation.

(NOTE: The center top of the secondary of this transformer is not usually grounded, when the transformer bank is operating at low voltage).

TASK

T-14 Hooking up a three phase transformer bank; Wye/Delta

PERFORMANCE OBJECTIVE

Hook-up, operate and test a three phase transformer bank connected Wye/Delta.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wye Delta connection
b. Wye Delta operation
c. Transformer ratio
d. Primary connection
e. Secondary connection
f. Applications

Provide Demonstration On:

a. Wye Delta operation
b. Ratio - volts and current
c. Wye Delta connection

Provide Practical Application On:

a. Wye Delta connection
b. Transformer ratio
c. (Series) high volts operation
d. (Parallel low volts operation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duff
b. Dunlap-Siefert-Austin

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. 3 one phase transformers
c. VOM
d. Power supplies
e. A/C amp meter
f. Resistive loads

CLASSROOM HOURS 20

EVALUATION (T-14)

Given three one phase dual voltage transformers, the necessary test equipment and power supplies, the student will: (1) make the wiring connections and operate a three phase bank connected Wye-Delta; (2) operate at high and low voltage three phase three wire; and (3) check and record all voltage readings. All wiring must meet local and national code standards and manufacturer's instruction for installation.

TASK

T-15 Hooking up a three phase transformer; Delta/Wye

PERFORMANCE OBJECTIVE

Hook-up, operate and test a three phase transformer bank connected Delta/Wye.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformer operation
b. Transformer ratio
c. Primary connection
d. Secondary connection
e. High volts connection
f. Low volts connection
g. Applications

Provide Demonstration On:

a. Transformer connection
b. Transformer ratio

Provide Practical Application On:

a. Transformer connection
b. Transformer ratio
c. Primary connection
d. Secondary connection
e. Series connection (high volts)
f. Parallel connection (low volts)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duff
b. Dulap-Siefert-Austin

A/Vs:

Long Filmslide Service, "Transformer"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. 3 one phase transformers
c. VOM
d. A/C amp meter
e. Resistive loads
f. Power supplies

CLASSROOM HOURS

20

EVALUATION (T-15)

Given three one phase dual voltage transformers, the necessary test equipment and power supplies, the student will: (1) make the wiring connections and operate a three phase bank connected Delta-Wye; (2) operate a three phase three wire and three phase four wire; and (3) check and record all voltage readings. All wiring must meet local and national code standards, and manufacturer's instructions for installation.

TASK

T-16 Hooking up a three phase transformer bank; reversed voltage

PERFORMANCE OBJECTIVE

Hook-up, operate and test a three phase transformer bank reversed voltage.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Three phase from 2 phase lines
b. Reversed voltage
c. Transformer operation
d. Neutral connection
e. Primary connection
f. Secondary connection
g. Applications

Provide Demonstration On:

a. Reversed voltage operation
b. Three phase from 2 phase lines

Provide Practical Application On:

a. Transformer operation
b. Transformer connection
c. Three phase from 2 phase lines
d. Transformer load capability

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duff
b. Dunlap-Siefert-Austin
c. Pender-Del-Mar

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Two single phase transformer
b. Shop tools
c. VOM
d. A/C amp meter
e. Power supply
f. Resistive loads

CLASSROOM HOURS 20

EVALUATION (T-16)

Given two one phase dual voltage transformers, the necessary test equipment and power supplies, the student will: (1) make the necessary wiring connections for operation of a three phase three wire open-Delta connected secondary; (2) connect the primary to two-phase lines of a three phase power supply; (3) operate the transformer bank at high voltage; and (4) check and record all voltage readings. All wiring must meet local and national code standards, and manufacturer's instructions for installation.

TASK

T-17 Hooking up transformers for special applications

PERFORMANCE OBJECTIVE

Hook-up, operate and test a three phase transformer for special application.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Special transformer application
b. Three phase 4-wire distribuiton
c. Three phase inter-connected wye
d. Six phase 6 wire
e. Six phase 6 wire double Delta
f. Scott 3 phase to 2 phase 4 wire
g. Scott 3 phase to 2 phase 3 wire
h. Tee connection 3 phase 3 wire
i. Synchronous rotary converter
j. Rotary converter

Provide Demonstration On:

a. Three phase inter-connected wire
b. Six phase 6 wire
c. Six phase 6 wire Double Delta
d. Scott 3 phase to 2 phase 3 and 4 wire
e. Tee connection

Provide Practical Application On:

continued on back

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duff
b. Pender-Del-Mar
c. Dunlap-Siefert-Austin
d. Croft-Carr-Watt

A/Vs:

Long Filmslide Service, "Transformers"

Student Manuals:

Standard Electric Time Bulletin

Tools and Equipment:

a. Shop tools
b. Proper transformer

CLASSROOM HOURS 20

EVALUATION (T-17)

Given three one phase three KVA transformers, the necessary test equipment and power supplies, the student will: (1) make the necessary wiring connections and operate a three phase transformer bank connected as the following:

1. 208v 3 phase 4 wire wye distribution
2. 360v 3 phase with neutral (inter-counnected wye) for three phase rotary connector
3. 105v 6 phase 6 phase rotary connector
4. 120v 6 phase 6 wire double delta
5. Scott connection 3 phase to 2 phase 4 wire
6. Scott connection 3 phase to 3 phase 3 wire
7. Tee connection 3 phase 3 wire;

and (2) check and record all voltage readings. All wiring must meet local and national code standards, and manufacturer's instruction for installation.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

a. Special transformer application
b. Three phase 4-wire distribution
c. Three phase inter-connected wye
d. Six phase 6 wire
e. Six phase 6 wire double Delta
f. Scott 3 phase to 2 phase 4 wire
g. Scott 3 phase to 2 pahse 3 wire
h. Tee connection 3 phase 3 wire
i. Synchronous rotary converter
j. Rotary converter

TASK

CW-01 Calculating service load for a small commercial building

PERFORMANCE OBJECTIVE

Calculate the total connected 3 phase 4 wire service load for a small commerical building.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. General lighting loads
b. Types of lighting
c. Special lighting loads
    1. Decorative
    2. Show window
    3. Night lights
    4. Emergency light
    5. Exit lights
d. General purpose outlets
e. Specific purpose outlets
f. Motor loads
g. Calculations for each of the above

Provide Demonstration On:

Load calculations for general lighting, special lighting, general and special purpose outlets and motor loads

Provide Practical Application On:

a. Load calculations
b. Total load calculations

INSTRUCTIONAL MATERIALS

Textbooks:

a. Ramsey and Sleeper
b. Building specifications
c. Croft-Carr-Watt
d. Summers
e. Heine-Dunlap-Jones

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #804A, "Planning and Roughing In"

Student Manuals:

Georgia, Industrial Electricity, Commercial Wiring, Unit CW-1

Tools and Equipment:

a. Set of prints
b. Scale
c. Shop tools
d. Specifications
e. Fixture catalog
f. Motor catalog
g. NEC
h. Fixture schedule

CLASSROOM HOURS

15

EVALUATION (CW-01)

Given a complete set of drawings for a commerical building, the student will calculate the total connected electrical service load. Calculations must be within 2% of correct answers. Power company service will be 115/230v 3 phase 4 wire Delta. Show all calculations.

1. Show the location of all service entrance equipment on the electrical drawing according to power company specifications.
2. Select the correct size and type service entrance conductors. (Copper or aluminum)
3. Select the correct size and type grounding conductor and note grounding method used.
4. Select the correct size and type of service conductors. All wiring methods and material selections must meet local and national code standards.

TASK

CW-02 Locating service entrance equipment and writing specifications

PERFORMANCE OBJECTIVE

Determine the locations of service equipment according to local power company specifications and the National Electric Code.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Location of service entrance equipment
b. Selection of service entrance equipment
c. Writing of specifications
d. Service entrance wire selection
e. Conduit selection
f. Conduit bending installation
g. Grounding of service

Provide Demonstration On:

a. Wire selection
b. Conduit selection
c. Conduit bending installation

Provide Practical Application On:

a. Conduit bending installation
b. Conduit selection
c. Write the service entrance specifications
d. Selection of service equipment
e. Installation of service equipment
f. Location of service entrance equipment
g. Grounding of service

INSTRUCTIONAL MATERIALS

Textbooks:

a. Ramsey and Sleeper
b. Graham
c. Summers

A/Vs:

a. Singer Career Systems, filmstrip and tape, #55-151, "Electric Wire and Cable"
b. Singer Career Systems, filmstrip and tape, #55-152, "Electrical Boxes"
c. AAVIM, slide tape, #AV305, "Electrical Wiring Residential -Utility Buildings-Service Areas"

Student Manuals:

Georgia, Industrial Electricity, Commercial Wiring, Unit CW-2

Tools and Equipment:

a. Complete set of prints
b. Specifications
c. Power company regulations
d. NEC

CLASSROOM HOURS

5

EVALUATION (CW-02)

Given a complete set of prints, specifications and power company regulations, the student will accurately: (1) complete the necessary calculations to determine the type and size of service equipment; (2) select the correct service entrance equipment, the necessary tools and materials; and (3) install the service equipment for a small commerical facility. The student will follow these steps:

1. Mount the 3 phase 4 wire service equipment on backboards secured to a concrete block wall.
2. Make the necessary bends and install service entrance conduits.
3. Install the service entrance and grounding conductors.
4. Connect to service equipment.
5. Connect service to a 115/230 3 phase 4 wire Delta power supply.
6. Operate and test all equipment.

All wiring must meet local and national code standards.

TASK

CW-03 Selecting a service entrance conductor

PERFORMANCE OBJECTIVE

Determine service entrance conductors according to NEC.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Copper conductors
b. Conductor insulation
c. Alum conductors
d. Single conductors
e. Conductors in parallel
f. Temperature rating

Provide Demonstration On:

Conductor selection

Provide Practical Application On:

Conductor selection

INSTRUCTIONAL MATERIALS

Textbooks:

Summers

A/Vs:

AAVIM, slide tape, #AV305, "Electrical Wiring Residential-Utility Buildings-Service Areas"

Student Manuals:

Georgia, Industrial Electricity, Commercial Wiring, Units CW-3 and CW-3a

Tools and Equipment:

a. NEC
b. Equipment catalog

CLASSROOM HOURS

10

EVALUATION (CW-03)

Given the service rating, the student will complete the necessary calculations to determine the best conductor selection for the service entrance.

1. Single copper conductor
2. Parallel copper conductor
3. Single aluminum conductor
4. Parallel aluminum conductor

TASK

CW-04 Calculating service conduits

PERFORMANCE OBJECTIVE

Complete calculation to determine the size and type of service conduits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of conduit
b. Size of conduit
c. Parallel conduits
d. Numbers of conductors in conduit
e. Supporting of conduit

Provide Demonstration On:

a. Conduit selection
b. Conduit percent fill

Provide Practical Application On:

Conduit selection

INSTRUCTIONAL MATERIALS

Textbooks:

Summers

A/Vs:

a. Singer Career Systems, filmstrip and tape, #55-156, "Electrical Service Entrance"
b. AAVIM, slide tape, #AV305 "Electrical Wiring Residential-Utility Buildings-Service Areas"

Student Manuals:

Georgia, Industrial Electricity Commercial Wiring, Unit CW-3

Tools and Equipment:

a. NEC
b. Supply catalog
c. Equipment catalog
d. Set of prints
e. Scale

CLASSROOM HOURS

10

EVALUATION (CW-04)

From a given set of prints, the student will complete the necessary calculations to determine the type and size of service conduits to be installed. All work must meet local and national electric code standards.

TASK

CW-05 Installing service conduits

PERFORMANCE OBJECTIVE

Select the proper size and type of conduit, make the necessary bends and install and support the conduit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Conduit bending
b. Conduit installing

Provide Demonstration On:

Conduit bending

Provide Practical Application On:

Conduit bending and installing

INSTRUCTIONAL MATERIALS

Textbooks:

Summers

A/Vs:

AAVIM, slide tape, #AV305, "Electrical Wiring Residential-Utility Buildings-Service Areas"

Student Manuals:

Georgia, Industrial Electricity, Commercial Wiring, Unit CW-3a

Tools and Equipment:

a. NEC
b. Set of prints
c. Shop tools
d. Conduit
e. Benders
f. Straps
g. Screws, nuts, bolts, etc.

CLASSROOM HOURS

10

EVALUATION (CW-05)

From a given set of prints, the student will:

1. Select the proper type of conduits;
2. Show (layout) the service conduits on the set of prints;
3. Show the size of conduit needed for the service;
4. Show the size of conduits to be used in parallel for the service; and
5. Make the necessary bends, install and support the conduit.

All work must meet local and national codes.

TASK

CW-06 Installing service entrance conductors

PERFORMANCE OBJECTIVE

Select, install and connect the service entrance conductors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Conductors
    1. Types
    2. Sizes
    3. Ampacity
    4. Copper vs aluminum
b. Number of conductors in a conduit
c. Parallel
d. Cost
e. Grounding service

Provide Demonstration On:

Conductor selection

Provide Practical Application On:

a. Conductor selection
b. Conductor installation

INSTRUCTIONAL MATERIALS

Textbooks:

Summers

A/Vs:

a. Singer Career Systems, filmstrip and tape, #55-156, "Electrical Service Entrance"
b. AAVIM, slide tape, #AV305, "Electrical Wiring Residential-Utility Buildings-Service Areas"

Student Manuals:

Georgia, Industrial Electricity, Commercial Wiring, Unit CW-3a

Tools and Equipment:

a. Set of prints
b. Shop tools
c. Fish tape
d. Wire tube
e. Wire

CLASSROOM HOURS 10

EVALUATION (CW-06)

From a given set of prints, the student will complete the necessary calculations to determine the proper size and type of service conductors (and grounding) and select and install these conductors in the conduits. All work must meet local and National Electric Codes.

TASK

CW-07 Selecting and installing meters

PERFORMANCE OBJECTIVE

Select and install meters.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Meter types
b. Meter sockets
c. Size and type meter for different service
d. Metering equipment

Provide Demonstration On:

a. CT installation
b. Meter installation

Provide Practical Application On:

Metering installation:
1. CT
2. In-line

INSTRUCTIONAL MATERIALS

Textbooks:

a. Summers
b. Equipment catalog

A/Vs:

Singer Career Systems, filmstrip and tape, #55-022, "Reading Electric Meters"

Student Manuals:

Georgia, *Industrial Electricity, Commercial Wiring*, Unit CW-4

Tools and Equipment:

a. Meter bases
b. Shop tools
c. Conduits
d. Cutters
e. Threaders
f. Power company regulation
g. NEC

CLASSROOM HOURS

10

EVALUATION (CW-07)

The student will select and install the correct measuring devices for a given service entrance accoring to Power Company regulations. The meter may be CT or in-line (CT for any service larger than 200 amps, in-line for any service less than 200 amps). All work must meet local and national codes.

TASK

CW-08 Selecting and installing panels

PERFORMANCE OBJECTIVE

Installing and making wiring connection for panels.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Panel ratings
b. Panel selection
c. Panel spacing and working space

Provide Practical Application On:

a. Load calculation to determine
b. Service equipment size
c. Service equipment selection
d. Panel installation and connection

INSTRUCTIONAL MATERIALS

Textbooks:

Summers

Student Manuals:

Georgia, Industrial Electricity, Commercial Wiring, Unit CW-4

Tools and Equipment:

a. Given load
b. Shop tools
c. Equipment catalog
d. NEC
e. Conductors
f. 208v 3 phase 4 wire power supply
g. 480v 3 phase 4 wire power supply

CLASSROOM HOURS

10

EVALUATION (CW-08)

For a given load the student will select, install and make wiring connections for a 480v 3 phase 4 wire service, following these steps:

1. List catalog number for the panel.
2. Outline in detail the procedure for determining bus length.
3. List by catalog number the breakers required.
4. Change the load to 208v 3 phase 4 wire and list the same information.

TASK

CW-09 Calculating and installing motor branch circuits

PERFORMANCE OBJECTIVE

Branch circuits and controls for 3 phase motors

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor name plate information
b. Locked rotor KVA
c. Code letters
s. Manual starters
e. Magnetic starters
f. Branch circuit overcurrent protection
g. Motor running overcurrent protection
h. Motor branch circuit conductor selection
i. Motor controls

Provide Demonstration On:

Motor branch circuit calculation

Provide Practical Application On:

a. Motor branch circuit calculation
b. Motor branch circuit installtion

INSTRUCTIONAL MATERIALS

Textbooks:

a. Rosenberg
b. Summers
c. Graham
d. Veinott
e. Croft-Carr-Watt

Student Manuals:

Square D manual #368-R2

Tools and Equipment:

a. Equipment catalog
b. 3 phase motor
c. Motor controls
d. Shop tools
e. Meter Vom
f. Amp meter a/c

(continued on back)

CLASSROOM HOURS

10

EVALUATION (CW-09)

a. Given a set of prints showing the location of service equipment and a 15 h.p. 230 volt 3 phase induction motor code F and the necessary test equipment and power supply, the student will complete the necessary calculations to determine:
   1. Motor branch circuit conductors size and type;
   2. Motor running overload protection; and
   3. Branch circuit overcurrent protection.

   Calculations must be based on National Electrical Code's standards and 100% correct.

b. After completing a., the student will, (1) select the required material; (2) install the conduits and controls on a plywood back board; (3) install branch circuits and control wiring; (4) complete all wiring connections; (5) test the circuitry; (6) connect to a power supply; and operate first the manual and secondly, the magnetic controls.

   All work must meet local and national code standards.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

g. Wiring material
h. Set of prints
i. Power supply
j. VOM
k. Amp meter

TASK

CW-10 Installing and operating subfeeders and panels

PERFORMANCE OBJECTIVE

Install and operate a 100 amp MLO subfeed panel

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Subfeeders
b. Panels
c. Rules governing the selection and installation of subfeeders
d. Location of sub panels

Provide Practical Application On:

a. Installtion of sub panels
b. Installation of subfeeder
c. Selection of conductors
d. Selection of sub panels

INSTRUCTIONAL MATERIALS

Textbooks:

a. Summers
b. Croft-Carr-Watt
c. Graham

Tools and Equipment:

a. Set of prints
b Shop tools
c. Conduit and benders
d. Panel
e. Power supply
f. Vom
g. Amp meter

CLASSROOM HOURS

10

EVALUATION (CW-10)

From a given set of prints, the student will: (1) show the location of all service equipment; and (2) select the required material, install and operate a 100 3 phase 4 wire amp MLO subpanel. Disconnect and overcurrent to be provided in main distribution equipment. Subpanel to be surface mounted and wired using ridgid conduit on a plywood backboard. Location of panel on board must be within one-eighth inch of specified measurement.

TASK

CW-11 Grouping outlets onto branch circuits

PERFORMANCE OBJECTIVE

Group outlets onto branch circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Grouping outlets onto branch circuits
b. Types of branch circuits
c. Number of conductors per conduit

Provide Practical Application On:

a. Calculate branch circuit loads.
b. Group these outlets onto branch circuits according to nature of loads.
c. Correct branch circuits overcurrent.
d. Show all conduits and home runs.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Summers

A/Vs:

Singer Career Systems, filmstrip and tape, #55-155, "Installing Electrical Boxes and Conduit"

Student Manuals:

Georgia, Industrial Electricity, Commercial Wiring, Unit CW-5

Tools and Equipment:

Set of prints showing outlets and loads NEC

CLASSROOM HOURS 10

EVALUATION (CW-11)

Given a floor plan of a commercial building, the student will: (1) show the locations of all general and special purpose outlets; (2) group these outlets onto branch circuits according to nature of loads; and (3) show all conduit home runs on prints. All wiring methods must meet local and national code standards.

TASK

CW-12 Installing specific purpose outlets

PERFORMANCE OBJECTIVE

Complete the necessary calculations for and install a specific branch circuit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical device selection and installation
b. Specific branch circuit
c. Device rating

Provide Demonstration On:

Electrical device selection

Provide Practical Application On:

Material selection and installation of a specific branch circuit

INSTRUCTIONAL MATERIALS

Textbooks:

Summers

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #804B, "Finishing the Installation"

Tools and Equipment:

a. Print
b. NEC
c. Ship tools
d. Electrical devices
e. Conduit
f. Boxes
g. Wiring material
h. Conduit benders
i. VOM
j. Power supply

CLASSROOM HOURS

10

EVALUATION (CW-12)

Given the requirements for a specific branch circuit in a commercial building, the student will:

1. Select the correct conduit;
2. Select the correct branch circuit conductors;
3. Select the correct branch circuit overcurrent protection device;
4. Select the correct boxes and fittings;
5. Select the correct devices for the circuit;
6. List the material; and
7. Install the circuit.

All work must meet local and national code standards.

TASK

CW-13 Calculating branch circuit conductors and overcurrent protection

PERFORMANCE OBJECTIVE

Calculate branch circuit wire size and overcurrent protection.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Branch circuit overcurrent protection
b. Type of branch circuit conductor
c. Number of conductors per branch circuit
d. Branch circuit conductor size
e. Branch circuit wiring installation and connection to overcurrent and loads

Provide Demonstration On:

a. Load calculations
b. Wire selection (type and size)
c. Branch circuit conductor installation and connection

Provide Practical Application On:

a. Calculate the load on branch circuits.
b. Select correct wire size to be installed.
c. Select proper type of conductors.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Summers
b. Carr-Croft-Watt

A/Vs:

Singer Career Systems, filmstrip and tape, #55-158, "Circuit Breakers"

Student Manuals:

Georgia, Industrial Electricity, Commercial Wiring, Unit CW-5

Tools and Equipment:

a. Set of prints
b. NEC
c. Wire
d. Power supply (panel)

CLASSROOM HOURS 10

EVALUATION (CW-13)

Given a floor plan of a commerical building, the student will accurately: (1) make the necessary calculation to determine the size and type of branch circuit conductors to be installed and the branch circuit overcurrent protection for these circuits; and (2) show all work and list material selection on prints. All calculations must meet or exceed local and national code standards.

TASK

CW-14 Installing branch circuits and controls for lighting

PERFORMANCE OBJECTIVE

Calculate for and install lighting branch circuit and controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. General illumination
b. Fluorescent lighting
c. Exit lights
d. Night lights
e. Emergency lights
f. Show window lighting
g. Lighting branch circuits
h. Control of lighting
i. Install fixtures
j. Grouping lights onto branch circuits
k. Layout of lights (arrangement)
l. Amount of lights (lumens)

Provide Practical Application On:

a. Lighting branch circuit installation
b. Installation of controls
c. Branch circuit calculation
d. Fixture installation
e. Group fixtures onto branch circuits
f. Amount of required light (lumens)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Graham
b. Summers
c. Croft-Carr-Watt

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #804A, "Planning and Roughing In"

Tools and Equipment:

a. Set of prints
b. Mat catalog
c. Wiring material
d. Shop tools
e. VOM
f. Power supply

CLASSROOM HOURS 10

EVALUATION (CW-14)

a. Given a set of prints showing branch circuits and equipment for lighting and lighting control, the student will select the required material for installing the specificied branch circuits and controls for:

   1. General illumination
   2. Exit lights
   3. Night lights
   4. Show window lighting
   5. Emergency lighting

   All equipment and material selection must meet local and national code standards.

b. The student will accurately (1) group the lights onto branch circuits; (2) show all work on the print and (3) complete a material selection list.

c. The student will install and operate a circuit which has one of each of the lights (listed in a) with controls.

All work must meet local and national code standards.

TASK

CW-15 Selecting conduit

PERFORMANCE OBJECTIVE

Calculate and select the branch circuit conduit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Overhead conduits
b. Under slab conduits
c. Number of conductors per conduit

Provide Demonstration On:

a. Conduit types
b. Conduit sizes
c. Per-cent fill of conduts

Provide Practical Application On:

Conduit selection

INSTRUCTIONAL MATERIALS

Textbooks:

Summers

Student Manuals:

Georgia, Industrial Eletricity, Commercial Wiring, Unit CW-6

Tools and Equipment:

NEC

CLASSROOM HOURS

5

EVALUATION (CW-15)

Given a floor plan of a commercial building, the student will accurately select the size and type conduit to be installed as branch circuit raceways (overhead and under slab) and show all conduit home runs, size and types on prints.

All material selection and sizes must be based on national code standards.

TASK

CW-16 Installing conduit under a concrete slab

PERFORMANCE OBJECTIVE

Select, install and secure conduit runs in a concrete slab.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Floor boxes
b. Material selection
c. Installation of under floor conduits
d. Floor elevations

Provide Demonstration On:

Securing conduits

Provide Practical Application On:

a. Floor box installation
b. Material selection
c. Installing conduits under a slab

INSTRUCTIONAL MATERIALS

Textbooks:

a. Summers
b. Croft-Carr-Watt
c. Graham

Student Manuals:

Georgia, Industrial Electricity, Commercial Wiring, Unit CW-7

Tools and Equipment:

a. Set of prints showing floor outlets
b. Shop tools
c. Conduits, benders and tools
d. NEC

CLASSROOM HOURS 10

EVALUATION (CW-16)

Given an electrical plan showing location of floor outlets and finish floor grades, the student will accurately select the necessary material, set the floor boxes to grade and install the conduit runs. All boxes and conduits must be secure to prevent dislocation while concrete floor is being poured. All work must meet local and national code standards.

TASK

CW-17 Installing outlet, junction and conduitlets

PERFORMANCE OBJECTIVE

Install the necessary conduitlets and boxes for conduit runs.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Boxes and conduitlets
b. Number of conductors per each
c. Number of conduits per each
d. Outlet and junction location
e. Conduit bending and installation
f. Conduit support
g. Conduits in masonary walls
h. Conduit exposed on masonary walls
i. Branch circuits

Provide Demonstration On:

a. Boxes and selection
b. Conduit bending
c. Conduit installation

Provide Practical Application On:

a. Boxes and conduitlet installation
b. Conduit bending
c. Conduit installation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Graham
c. Summers

Tools and Equipment:

a. Set of prints
b. Shop tools
c. Conduit and fittings
d. Boxes
e. Conduit benders
f. Wire
g. Fish tape

CLASSROOM HOURS 10

EVALUATION (CW-17)

Given a set of prints showing panel and outlet locations, the student will accurately select the proper materials, mount the required boxes and conduitlets, make the necessary conduit bends and install the conduit runs. All boxes, outlets and fittings must be within one fourth inch of specifications. The student will install the branch circuit conductors and make the required wiring connection for complete installation of branch circuits, and operate and test all wiring. All work must meet local and national code standards.

TASK

CW-18 Installing branch circuits and controls for air conditioning and heating

PERFORMANCE OBJECTIVE

Install and operate the branch circuits and starter for air conditioning and heating equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. EMT conduit
b. EMT bending
c. Motor starters and control
d. Motor starter selection and installation
e. Branch circuit and feeder calculation

Provide Demonstration On:

a. EMT bending and installation
b. Motor starter installation
c. Control selection

Provide Practical Application On:

a. EMT conduit bending
b. Motor starter installation
c. Control hook-up
d. Branch circuit mat selection and installation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Summers
b. Croft-Carr-Watt
c. Graham
d. Althouse-Turnquist-Bracciano

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #833, "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning-Part One"

Tools and Equipment:

a. Set of prints
b. Shop tools
c. EMT conduit
d. Conductors
e. Motor starters
f. Power supply
g. VOM
h. Amp meter

CLASSROOM HOURS 10

EVALUATION (CW-18)

Given a set of prints showing the locations and rating of electric heating and cooling equipment, the student will: (1) complete the necessary calculations to determine the branch circuit and feeder requirements based on National Electrical Code standards; and (2) select the required material and install and operate the required branch circuits and equipment. Branch circuits wiring is to be installed in proper size EMT conduit. All equipment is to be mounted on three-fourth inch plywood backboard within one-eighth inch of specified measurement. All work must meet local and national code standards.

TASK

CW-19 Selecting and installing branch circuits for 3 phase water heaters

PERFORMANCE OBJECTIVE

Install and operate the branch circuit for a 3 phase water heater.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. 3 phase loads Delta and Wye
b. 3 phase branch circuits
c. Material selection
d. Branch circuit overcurrent protection selection and installation
e. Disconnect
f. Load calculations
g. 3 phase branch circuits from panels

Provide Demonstration On:

a. 3 phase loads Delta and Wye
b. 3 phase branch circuits
c. Load calculations

Provide Practical Application On:

a. Load calculations
b. Branch circuit material
c. Selection
d. Branch circuit installation
e. Connection to 3 phase load

INSTRUCTIONAL MATERIALS

Textbooks:

a. Summers
b. Croft-Carr-Watt
c. Graham
d. Manufacturer's Catalog

A/Vs:

Bergwall Production, Inc.,
filmstrips/cassettes, #804B,
"Finishing the Installation"

Tools and Material:

a. Set of prints
b. Branch circuit material
c. Power supply
d. Shop tools
e. Power supply
f. VOM
g. Amp meter

CLASSROOM HOURS 10

EVALUATION (CW-19)

Given a set of prints showing the location and rating of a 3 phase 230v electric water heater, and given access to material and equipment, the student will: (1) complete all necessary calculations to determine the branch circuit capacity necessary for proper operation of the water heater; and (2) select, install and operate the branch circuit. Wiring will be installed in EMT mounted on a concrete block wall. All equipment must be mounted within one-fourth inch of drawing specifications. All work must meet local and national code standards.

TASK

IW-01 Planning and performing site work for a small industrial facility

PERFORMANCE OBJECTIVE

Complete plot plan and site work for a small industrial facility.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Location of utilities on building site
b. Location of building on plot plan
c. Property lines
d. Prepare location of electrical service
e. Voltage and transformer bank for industrial service
f. Overhead and underground service installation

Provide Demonstration On:

a. Voltage and KVA rating of transformers
b. Transformer hook-up
c. Overhead and underground service entrance.
d. Transformer installation

Provide Practical Application On:

a. Planning site work
b. Location and installation of service equipment as per specifications and NEC
c. Transformer hook-up and installation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Graham
c. Summers

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #804A, "Planning and Roughing In"

Tools and Equipment:

a. Set of prints
b. Set of specifications
c. Engineer scale

CLASSROOM HOURS 10

EVALUATION (IW-01)

From a given set of prints and the electrical specifications, the student will accurately determine:

a. Service locations
b. Service overhead/underground
c. Location of transformer
d. Proper bank of transformers
e. The correct service voltage
f. Determine any conflicts with other utilities

TASK

IW-02 Making calculations for electric motors, welders and heaters

PERFORMANCE OBJECTIVE

Make calculations for electric motors (480v 3 phase, 208v 3 phase, 208v 1 phase, 120v 1 phase) and welders.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor nameplate information
b. Single phase motors
c. Three phase motors
d. Three phase and single phase motor operations
e. Welder nameplate information
f. Single phase welders
g. Three phase welders
h. Welder operation
i. NEC article 430, 630, 220, 424
j. Heater nameplate information
k. Single phase electric heaters
l. Three phase electric heaters

Provide Demonstration On:

a. Operation of single phase and three phase motor and welders
b. Motor nameplate information
c. Welder nameplate information
d. Operation of single and three phase heaters
e. Heater nameplate information
f. Load calculations

Provide Practical Application On:

(continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Summers

A/Vs:

Hobar Publications, slide/tape, #471, "Electric Motors: Enclosures, Bearings and Mounting Methods"

Tools and Equipment:

a. Set of prints with motor and welder load
b. NEC

CLASSROOM HOURS

10

EVALUATION (IW-02)

From a given set of prints, the student will accurately calculate the total connected motor, welder, and heat load to determine the correct branch circuit wire size for each and the correct feeder wire size.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

a. Motor branch circuit and feeder calculations
b. Welder branch circuit and feeder calculations
c. Heater branch circuit and feeder calculations
d. Selection of branch circuit and feeder wire size

TASK

IW-03 Calculating the 120 and 277 volt lighting load

PERFORMANCE OBJECTIVE

Make calculations for 120 volt and 277 volt lighting loads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Light fixtures
b. Grouping fixtures or branch circuits
c. Arrangement of fixtures (layout)
d. Calculations for lighting loads
e. Selection of fixtures

Provide Demonstration On:

a. Grouping of fixtures on branch circuit
b. Fixture layout
c. Branch circuit calculations

Provide Practical Application On:

a. Layout of the light fixtures
b. Group the fixtures on branch circuit
c. Calculations of lighting branch circuits

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's catalogs
b. Croft-Carr-Watt
c. Graham
d. Summers

A/Vs:

Hobar Publications, slide/tape, #415, "Wiring a Switch and Lamp"

Tools and Equipment:

a. Set of prints
b. NEC
c. Fixture catalog
d. Fixture specifications
e. Scale

CLASSROOM HOURS

10

EVALUATION (IW-03)

From a given set of prints, the student will accurately complete the necessary calculations to determine the number and type of lighting fixtures needed for proper amount of light, grouping the fixtures on branch circuits.

TASK

IW-04 Calculating and selecting receptacles for 120/208 volt loads

PERFORMANCE OBJECTIVE

Calculate the 120/208 volt receptacles load and select the proper receptacles.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. NEMA standards
b. Receptacles (voltage and current rating)
c. Wire selection and ampacities
d. Conduit selection
e. Load calculations

Provide Demonstration On:

a. Receptacles selection
b. Load calculations
c. Branch circuit overcurrent selection

Provide Practical Application On:

a. Branch circuit load calculations
b. Grouping of outlets on branch circuits
c. Branch circuit overcurrent selections
d. Locating conduit runs
e. Determine number of conductors per conduit
f. Branch circuit wire size selection

INSTRUCTIONAL MATERIALS

Textbooks:

a. Graham
b. Summers

Tools and Equipment:

a. NEMA device configurations
b. NEC
c. Prints

CLASSROOM HOURS 10

EVALUATION (IW-04)

From a given set of prints, the student will accurately calculate the 120/208 volt receptacles outlet load, group the outlets onto branch circuits, select the correct wire, select the proper overcurrent for each branch circuit, select the proper size of conduit, and show conduit runs on print. Work must conform to NEMA standards.

TASK

IW-05 Calculating size for and selecting and installing a Buss-Duct

PERFORMANCE OBJECTIVE

Calculate load on, select, install and operate a 3 phase, 4 wire Buss-Duct system

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Buss-Duct system
b. Motor loads
c. Buss-Duct selection
d. Buss-Duct installation
e. Buss-Duct operation
f. Branch circuit selection

Provide Demonstration On:

a. Motor load calculation
b. Buss-Duct selection
c. Buss-Duct installation

Provide Practical Application On:

a. Buss-Duct selection
b. Buss-Duct installation
c. Buss-Duct protection
d. Buss-Duct branch circuits
e. Buss-Duct operation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's catalog
b. Croft-Carr-Watt
c. Graham
d. Summers

Tools and Equipment:

a. Set of prints
b. Motor FLA
c. NEC
d. Required shop tools

CLASSROOM HOURS 10

EVALUATION (IW-05)

From a given set of prints showing motor layout, motor voltage and current rating, the student will accurately calculate the total connected motor load, select the correct size and lengths of Buss-Duct, the proper size of Buss-Duct overcurrent protection, and the proper size branch circuit overcurrent protection for each motor; and install a ten foot length of Buss-Duct.

TASK

IW-06 Selecting and installing a 3 phase, 4 wire 480v panel

PERFORMANCE OBJECTIVE

Select, install and make wiring connection for a 3 phase, 4 wire 480v panel.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformer outputs
b. Transformer hook-ups
c. Types of panels
d. Wire ampacities
e. Conduit types and sizes
f. Bus bar length
g. Panel installation

Provide Demonstration On:

a. Transformer hook-up
b. Transformer output
c. Panel installation and hook-ups

Provide Practical Application On:

a. Transformers
b. Panel installation and hook-ups

INSTRUCTIONAL MATERIALS

Textbooks:

a. Adams
b. Croft-Carr-Watt
c. Hubert
d. Summers

A/Vs:

Hobar Publications, filmstrip Unit 1 (EW0010), "Electrical Connections and Current Control"

Tools and Equipment:

a. Catalog
b. NEC
c. Required shop tools
d. Test equipment
e. Set of prints

CLASSROOM HOURS 10

EVALUATION (IW 06)

From a given set of points or load, the student will accurately complete the necessary calculations to determine the appropriate size and type of 480v 3 phase, 4 wire panel; select, install and correct to the proper power supply in phase sequence A, B, C; and operate a 3 phase branch circuit from panel.

TASK

IW-07 Selecting the correct transformer bank

PERFORMANCE OBJECTIVE

Complete the necessary calculations to determine the size and type transformer bank.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Transformer selection application
b. Installation
c. Load calculations
d. Panel selection
e. Wire size and type
f. Conduit selection
g. Service grounding
h. Grounding wire size selection
i. Length of panel bus bars

Provide Demonstration On:

a. Transformer selection
b. Load calculations
c. Panel bus bar length

Provide Practical Application On:

Transformer installation and hook-up

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's catalog
b. Summers

Tools and Equipment:

a. Set of prints w/loads
b. NEC equipment catalog

CLASSROOM HOURS 6

EVALUATION (IW-07)

The student will accurately complete the necessary calculations to determine the correct KVA size transformer bank to supply a small industrial facility; and make the proper wiring connection and operate the transformer bank 480/277-208/120. Work must meet NEC specifications.

TASK

IW-08 Selecting and installing a 480v/208-120 3-phase 4 wire service

PERFORMANCE OBJECTIVE

Select, install and operate the service 480v/208-120 3-phase 4 wire from a bank of transformers

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. 1 phase transformer bank
b. 3 phase transformers
c. KVA rating
d. Panels
e. Circuit breaker selection and installation

Provide Practical Application On:

a. Making a transformer hook-up (480v/277v 3-phase 4 wire panel installation)
b. Installing circuit breakers (3 pole, 2 pole, 1 pole)
c. Installing branch circuits from panels
d. Making a panel and service grounding

INSTRUCTIONAL MATERIALS

Textbooks:

a. Supply catalogs
b. Croft-Carr-Watt

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-6

Tools and Equipment:

a. Shop tools
b. Set of prints
c. Catalog
d. Panels
e. Circuit breakers
f. Meter VOM

CLASSROOM HOURS 10

EVALUATION (IW-08)

From a given set of prints, the student will accurately calculate the load for a small industrial facility; select the proper transformer bank; select, install, and operate the service entrance panels 480v/277-208/120v 3-phase 4 wire; and install the circuit breakers in these panels for any loads that may be fed from these panels. Work must conform to NEC standards.

TASK

IW-09 Installing metering equipment

PERFORMANCE OBJECTIVE

Install a 200 amp 3-phase 4 wire meterbase and install a CT meter base.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Local and NEC codes
b. Equipment selection
c. Equipment installation
d. Utility company requirement for this class electrical service

Provide Demonstration On:

Procedures for installing meter base

Provide Practical Application On:

a. Installation of 3-phase 4 wire series metering equipment
b. Installation of CTs

INSTRUCTIONAL MATERIALS

Textbooks:

a. Local Codes
b. Summers
c. Croft-Carr-Watt
d. Hubert

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Units IW-6 and IW-7

Tools and Equipment:

a. Shop tools
b. Set of prints
c. NEC
d. Local codes

CLASSROOM HOURS

10

EVALUATION (IW-09)

From a given set of prints, the student will accurately complete the necessary calculations to determine service size and:

1. Select and install the service metering equipment for a 3-phase 4 wire 200 amp service; and
2. Select and install the service metering equipment for a 3-phase 4 wire 300 amp service.

All work must meet local and NEC standards.

TASK

IW-10 Selecting and installing panels and selecting distribution equipment

PERFORMANCE OBJECTIVE

Select and install subfed panels (main and main lugs only)

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sub feeders
b. Types of panels
c. Distribution equipment
d. Subfeeders and selection
e. Cable trays
f. Gutters
g. Raceways
h. Duct system
i Junction boxes
j. Phase rotation

Provide Demonstration On:

Phase rotation procedure

Provide Practical Application On:

a. Selection and installation of distribution equipment
b. Selection and installation of sub-panels
c. Installation of:
    1. Cable trays
    2. Gutters
    3. Raceways
    4. Duct systems
    5. Junction boxes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Summers
b. Manufacturer's catalogs
c. Adams
d. Hubert

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-12

Tools and Equipment:

a. Equipment catalog
b. NEC
c. Set of prints
d. Shop tools
e. Phase rotation tester

CLASSROOM HOURS 10

EVALUATION (IW-10)

From a given set of prints, the student will accurately complete the necessary calculations to determine the type and size distribution equipment; and select and install the correct raceway system, and the subfeeders and panels. Work must meet electrical code standards.

TASK

IW-11 Selecting and installing a 277v fluorescent light

PERFORMANCE OBJECTIVE

Determine lighting requirements and select and install a fluorescent light.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Light output
b. Light selection
c. Placement of light
d. Operation of fluorescent light

Provide Demonstration On:

a. Calculating lighting requirements
b. Procedures for installing fluorescent light

Provide Practical Application On:

a. Calculation of light output
b. Installing light

INSTRUCTIONAL MATERIALS

Textbooks:

a. Fixture catalog
b. Croft-Carr-Watt
c. Graham

A/Vs:

a. Bergwall Productions, Inc., filmstrips/cassettes, #804B, "Finishing the Installation"
b. Bergwall Productions, Inc., filmstrip/cassettes, #804C, "Low Voltage and Special Circuits"

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-13

Tools and Equipment:

a. Shop tools
b. 277v fluorescent light
c. Set of prints

CLASSROOM HOURS 8

EVALUATION (IW-11)

From a given set of prints, the student will accurately determine the number of fluorescent lights needed to provide adequate light; select the type needed, show placement of the fixtures; arrange the lights onto branch circuits; install a 277v fluorescent light fixture; make wiring connections and operate the light. The installation should meet all code requirements.

TASK

IW-12 Determining sizes and types of feeders and overcurrent protection devices

PERFORMANCE OBJECTIVE

Determine size of feeders and overcurrent protection.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Feeder selection
b. Overcurrent protection selection
c. Motor nameplate

Provide Demonstration On:

Feeder calculations and selection

Provide Practical Application On:

a. Selection of feeder circuit conductors.
b. Selection of feeder overcurrent protective device

INSTRUCTIONAL MATERIALS

Textbooks:

a. Summers
b. Croft/Carr-Watt

A/Vs:

Hobar Publications, filmstrip, Unit 1 (EW0010), "Electrical Connections and Current Control"

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-16

Tools and Equipment:

a. Prints
b. NEC

CLASSROOM HOURS 10

EVALUATION (IW-12)

From a given set of prints, the student will accurately complete the necessary calculations to determine the correct size and type of feeder and overcurrent protective device for a group of 480v 3 phase motors. Determinations should be accurate and agree with local code requirements.

TASK

IW-13 Installing a branch circuit for welders

PERFORMANCE OBJECTIVE

Determine the size of conductors and overcurrent protective device for welders.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Welder nameplate
b. Welder operation

Provide Demonstration On:

Welder branch circuit and welder calculation

Provide Practical Application On:

Welder branch circuit and feeder selection and installation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Van Valkenburgh
c. Summers

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-19

Tools and Equipment:

a. Shop tools
b. Set of prints

CLASSROOM HOURS

10

EVALUATION (IW-13)

From a given set of prints, the student will accurately complete the necessary calculations to determine the proper size branch conductors and overcurrent protection for a transformer arc welder and resistance welders (manual and automatically fed); and install and operate these circuits. All work must meet the NEC requirements.

TASK

IW-14 Operating a split phase motor

PERFORMANCE OBJECTIVE

Operate and check the start and run characteristics of a split phase motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor operation and winding
b. Motor nameplate
c. Load characteristics
d. Torque characteristics
e. Dual volts motors
f. Efficiency
g. Applications

Provide Demonstration On:

a. Direction of rotation of single phase motor
b. Load characteristics of a split phase motor
c. Torque characteristics of split phase motor
d. Applications of split phase motors

Provide Practical Application On:

a. Direction of rotation of single phase motor
b. Load characteristics of a split phase motor
c. Torque characteristics of split phase motor
d. Applications of split phase motors

INSTRUCTIONAL MATERIALS

Textbooks:

a. Veinott
b. Rosenberg
c. Croft-Carr-Watt

A/Vs:

AAVIM, Slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

a. Hampden
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-20

Tools and Equipment:

a. Shop tools
b. Meters A/C volt-amp-watt
c. Motor and equipment
d. Motor standards
e. Power supply
f. Motor loads

CLASSROOM HOURS

8

EVALUATION (IW-14)

Given a split phase motor, the necessary test equipment and power supply, the student will accurately operate and check the following motor characteristics: torque, start amps, full load amps, speed and efficiency. Use NEMA standards for comparison.

TASK

IW-15 Operating a capacitor start motor

PERFORMANCE OBJECTIVE

Operate and check the start and run characteristics of a capacitor start motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor capacitor
b. Motor nameplate
c. Motor operation and winding
d. Torque characteristic
e. Load characteristic

Provide Demonstration On:

How to operate, hook-up and calculate the load characteristics of capacitor motors torque, speed, start amps efficiency, FLA)

Provide Practical Application On:

a. Determining starting characteristics of a capacitor start motor
b. Determining load characteristics of a capacitor motor
c. Determining torque characteristics of a capacitor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Veinott
b. Rosenberg
c. Croft-Carr-Watt

A/Vs:

AAVIM, slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

a. Hampden
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-22

Tools and Equipment:

a. Shop tools
b. Meters A/C volt-amp-watt
c. Motor and equipment
d. Motor standards
e. Power supply
f. Motor loads

CLASSROOM HOURS 8

EVALUATION (IW-15)

Given a capacitor start motor and the necessary test equipment, and power supplies, the student will accurately operate and check the following motor characteristics: torque, start amps, full load amps, speed, and efficiency. Use NEMA standards for comparison.

TASK

IW-16 Operating a universal motor

PERFORMANCE OBJECTIVE

Operate and check the start and run characteristics of a universal motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Universal motor
b. Motor nameplate
c. AC operation
d. DC operation
e. Forward/reverse operation
f. Load characteristic
g. Speed control
h. Applications
i. Motor efficiency AC/DC

Provide Demonstration On:

Hooking up, operating and checking the characteristics of a universal motor

Provide Practical Application On:

a. Forward/reverse operation of motor
b. Speed control
c. DC operation of motor
d. AC operation of motor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Veinott
b. Rosenberg
c. Adams

A/Vs:

AAVIM, slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-25

Tools and Equipment:

a. Shop tools
b. Meters AC and DC volt-amp-watt
c. Motor and equipment
d. Motor standards
e. Power supplies AC and DC
f. Motor loads

CLASSROOM HOURS 8

EVALUATION (IW-16)

Given a universal motor and the necessary test equipment, and power supplies, AC and DC, the student will accurately hook-up, operate and check the following motor characteristics: torque, start amps, full load amps, speed and efficiency for A/C and D/C operation. Use NEMA standards for comparison.

TASK

IW-17 Operating a 3-phase induction motor

PERFORMANCE OBJECTIVE

Operate and check the load characteristic of a 3-phase induction motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor nameplate information
b. 3 phase induction motor
c. 3 phase power
d. Forward and reverse operation
e. Load characteristic
f. Start characteristic
g. Run characteristic
h. Motor efficiency
i. Applications

Provide Practical Application On:

a. Forward/reverse operation
b. Applications
c. Dual volts motors
d. Starting characteristic and direction of rotation
e. Torque characteristic of 3-phase induction motors
f. Load characteristics of 3-phase induction motors
g. Efficiency of a 3-phase induction motor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Veinott
b. Rosenberg

A/Vs:

AAVIM, slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-27

Tools and Equipment:

a. Shop tools
b. Motor and equipment
c. Meters A/C volt, amp, watt
d. Motor standards
e. Power supply
f. Motor load

CLASSROOM HOURS 8

EVALUATION (IW-17)

Given a 3-phase induction motor, the necessary test equipment and power supply, the student will accurately, hook-up, operate and check the following motor characteristics: torque, start amps, full load amps, speed, and efficiency. Use NEMA standards for comparison.

TASK

IW-18 Operating a 3-phase synchronous motor

PERFORMANCE OBJECTIVE

Operate and check the characteristics of a 3-phase induction motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. 3-phase synchronous motor
b. Speed control
c. Motor nameplate
d. Motor operation
e. Motor load characteristics
f. Motor start characteristics
g. Motor efficiency
h. Motor applications

Provide Demonstration On:

How to hook-up, operate and check the characteristics of a 3-phase induction motor

Provide Practical Application On:

a. Speed control
b. Motor operation
c. Motor start, run, torque
d. Characteristics

INSTRUCTIONAL MATERIALS

Textbooks:

a. Adams
b. Croft-Carr-Watt

A/Vs:

AAVIM, slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

a. Hampden
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-29

Tools and Equipment:

a. Shop tools
b. Motor and equipment
c. Meters AC, volt-amp-watt
d. Motor standards
e. Power supply
f. Motor load

CLASSROOM HOURS	10

EVALUATION (IW-18)

Given a 3-phase synchronous motor, the necessary test equipment, and power supply, the student will accurately hook-up, operate and check the following motor characteristics: torque, start amps, full load amps, speed, and efficiency. Use NEMA standards for comparison.

TASK

IW-19 Operating a 3-phase 1 winding, 2 speed motor

PERFORMANCE OBJECTIVE

Operate and check the characteristics of a 1 winding 2 speed motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor nameplate
b. Motor windings
c. Motor winding connections
d. Motor RPM
e. Motor connection to the line
f. Motor operation at each speed
g. Motor horsepower
h. Motor torque

Provide Demonstration On:

a. Demonstrate motor magnetic pole relationships
b. Making motor winding identification
c. Making motor lead connection

Provide Practical Application On:

a. Motor winding identification
b. Motor lead identification
c. Motor lead connection
d. Motor connection to line
e. Direction of rotation
f. Motor operation low and high speed

INSTRUCTIONAL MATERIALS

Textbooks:

a. Hubert
b. Siskind (1)
c. Rosenberg
d. Siskind (2)

A/Vs:

AAVIM, slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

Hampden

Tools and Equipment:

a. Shop tools
b. Motor 3-phase 1 winding 2 speed
c. Test meter (VOM)
d. A/C amp-meter
e. Power supply
f. Motor loads
g. Strobotach

CLASSROOM HOURS

8

EVALUATION (IW-19)

Given a 1 winding 2 speed 3-phase motor, the necessary test equipment, and power supply, the student will accurately, hook-up, operate and check the following characteristics: torque, horsepower, start amps, full load amps, speed and efficiency.

TASK

IW-20 Operating a 3-phase 2 winding, 2 speed motor

PERFORMANCE OBJECTIVE

Operate and check the characteristics of a 2 winding, 2 speed motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor nameplate
b. Motor windings
c. Motor connections (windings)
d. Motor RPM
e. Motor connection to line
f. Motor operation on each winding
g. Motor horsepower
h. Motor torque

Provide Demonstration On:

a. Demonstrate motor magnetic pole relationships
b. Making motor winding identification

Provide Practical Application On:

a. Motor winding identification
b. Motor leads identification
c. Motor connection to line
d. Direction of rotation
e. Motor operation low and high speed

INSTRUCTIONAL MATERIALS

Textbooks:

a. Hubert
b. Siskind (1)
c. Rosenberg
d. Siskind (2)

A/Vs:

AAVIM, slide/tape, AV300, "How Electric Motors Start and Run"

Student Manuals:

a. Hampden
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-31

Tools and Equipment:

a. Shop tools
b. Motor 3-phase 2 winding, 2 speed
c. Test meter (VOM)
d. A/C amp-meter

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CLASSROOM HOURS 8

EVALUATION (IW-20)

Given a 2 winding 2 speed 3 phase motor, the necessary test equipment, and power supplies, the student will accurately, hook-up, operate and check the following characteristics: torque, horsepower, start amps, full load amps, speed and efficiency. Use NEMA standards for comparison.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. Power supply
f. Motor load
g. Strobotach

TASK

IW-21 Operating single and three phase alternators

PERFORMANCE OBJECTIVE

Operate and check under load conditions for single and three phase alternators.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Alternators above and below rated speed
b. Alternators above and below rated volts
c. Alternators operating and unity power factor
d. Alternators operating at lagging power factor
e. Alternators operating at leading voltage factor
f. Voltage regulation of alternators

Provide Demonstration On:

Hooking up and performing load tests on alternators

Provide Practical Application On:

a. Operation of alternators above and below rated speed
b. Operation of alternators above and below rated volts
c. Operation of alternators at unity power factor
d. Operation of alternators at lagging power factor
e. Operation of alternators at leading power factor
f. Voltage regulation of alternators

INSTRUCTIONAL MATERIALS

Textbooks:

a. Adams
b. Timble and Willson
c. Siskind (1)
d. Duff
e. Siskind (2)

Student Manuals:

a. Hampden
b. Standard Electric Time Bulletin
c. Georgia, Industrial Electricity, Industrial Wiring, Units IW-32 through IW-39

Tools and Equipment:

a. Shop tools
b. Alternator
c. Motors A/C and D/C
d. Meter "VOM"
e. DC amp meter
f. AC amp meter
g. Loads for alternator
h. Power supplies AC and DC

CLASSROOM HOURS 8

EVALUATION (IW-21)

Given a single and a three phase alternator, the necessary test equipment, power supplies, and loading equipment, and rotating machinery, the student will accurately, hook-up, operate and perform the following load test on the alternators:

1. Above and below rated speed.
2. Above and below rated volts.
3. Test the alternators' lagging, leading, and unity power factor.
4. Demonstrate voltage regulations of alternators. Record the data from each test.
5. Hook-up and operate a 254v 1 phase alternator.
6. Hook-up and operate a 508v 1 phase alternator.
7. Hook-up and operate a 220/440v 3 wire 1 phase alternator.
8. Hook-up and operate a 122v 2 parallel Delta alternator.
9. Hook-up and operate a 220v 2 parallel Wye alternator.
10. Hook-up and operate a 254v series Delta alternator.
11. Hook-up and operate a 44v series Wye alternator.
12. Hook-up and operate a 380v interconnected Wye alternator.
13. Hook-up and operate a 127v double Delta alternator.
14. Hook-up and operate a 127v parallel diametrical alternator.
15. Hook-up and operate a 254v series daimetrical alternator.

TASK

IW-22 Operating an induction regulator

PERFORMANCE OBJECTIVE

Hook-up and test under load an induction regulator

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Induction regulator
b. Transformers

Provide Demonstration On:

Making connections for and operating a three phase induction regulator

Provide Practical Application On:

a. Induction regulator
b. Volts-output
c. Amp-output
d. Load capability

INSTRUCTIONAL MATERIALS

Textbooks:

a. Van Volkenburgh
b. Siskind (1)
c. Pender-Del Mar

Student Manuals:

a. Standard Electric Time Bulletin
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-41

Tools and Equipment:

a. Motor generator set
b. Shop tools
c. Meters (VOM)
d. A/C amp-meter
e. Power supply

CLASSROOM HOURS 5

EVALUATION (IW-22)

Given the required machineray and control equipment and components, the necessary test equipment, and power supplies, the student will accurately make the wiring connections, and operate the three-phase induciton regulator at 220-440 volts. Test load may be resistive or inductive.

TASK

IW-23 Operating a rotary frequency changer

PERFORMANCE OBJECTIVE

Hook-up and operate a frequency changer 0-60 cycles 220v, and 60-120 cycles 215 -440 volts

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Frequency changers
b. Driven with synchronous field
c. Driven against synchronous field
d. RPM of frequency changers

Provide Demonstration On:

Making wiring connections for and operating a frequency changer

Provide Practical Application On:

a. Operation of frequency changers
b. Operation with synchronous field
c. Operation against synchronous field
d. Rotation of frequency changer
e. RPM of frequency changer
f. Motor driver

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Siskind (1)
c. Siskind (2)

Student Manuals:

a. Standard Electric Time Bulletin
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-42.

Tools and Equipment:

a. Motor/generator set
b. Shop tools
c. Meters VOM, frequency counter
d. Power supply

CLASSROOM HOURS 8

EVALUATION (IW-23)

Given the required machinery and control components, the necessary test equipment and power supplies, the student will accurately make the wiring connections, and operate the 3 phase frequency changer with rotor driven synchronous field rotation 0-60 cycles - 220 volts; and operate the 3 phase frequency changer driven against synchronous field rotation 60-120 cycles 215-440 volts.

TASK

IW-24 Operating a synchronous rotary converter

PERFORMANCE OBJECTIVE

Hook-up and operate a synchronous rotary converter (AC to DC).

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Rotary converter
b. Operation of synchronous rotary converters
c. Converting AC to DC
d. Phasing

Provide Demonstration On:

How to convert AC to DC

Provide Practical Application On:

a. Operation of synchronous rotary converters
b. Converting AC to DC

INSTRUCTIONAL MATERIALS

Textbooks:

a. Timble and Willson
b. Croft-Carr-Watt

Student Manuals:

a. Standard Electric Time Bulletin
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-43

Tools and Equipment:

a. Motor/generator
b. Shop tools
c. Meter VOM
d. Loads
e. Power supply
f. D/C amp meter

CLASSROOM HOURS 8

EVALUATION (IW-24)

Given the required machinery and control components, the necessary test equipment, and power supplies, the student will accurately make the wiring connections and operate a synchronous rotary converter (AC to DC) self excited; and test the converter using a 125 volt 2.5 ampere resistor load.

TASK

IW-25 Operating a rotary converter

PERFORMANCE OBJECTIVE

Hook-up and operate a rotary converter (DC to AC).

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Rotary converters
b. Operation of rotary converters
c. Converting DC to AC

Provide Demonstration On:

Converting DC to AC

Provide Practical Application On:

a. Operation of a rotary converter
b. Converting AC to DC

INSTRUCTIONAL MATERIALS

Textbooks:

a. Pender-Del Mar
b. Siskind (1)
b. Siskind (2)

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #810, "Rotary Machinery Explained-Direct Current Motors"

Student Manuals:

a. Standard Electric Time Bulletin
b. Georgia, Industrial Electricity, Industrial Wiring, Unit IW-44

Tools and Equipment:

a. Motor/generator
b. Shop tools
c. Meter VOM
d. Load (AC)
e. Amp-meter A/C
f. Power supply

CLASSROOM HOURS

8

EVALUATION (IW-25)

Given the required machinery and control components, the student will accurately make the wiring connections and operate a rotary converter (DC to AC); and test the rotary converter with a 7 amp load at 70 volts 3 phase.

TASK

IW-26 Operating DC motors

PERFORMANCE OBJECTIVE

Check operating characteristics of series, shunt and compound DC motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Series DC motors
b. Shunt DC motors
c. Compound DC motors
d. Load characteristic of each
e. Speed characteristic of each
f. Torque characteristic of each
g. Start amps of each
h. Full load amp of each
i. Speed and efficiency of each
j. Forward and reverse of each
k. Application of each

Provide Demonstration On:

a. Series windings of DC motors
b. Shunt wound DC motors
c. Compound wound DC motors

Provide Practical Application On:

a. Operation of series DC motors
b. Operation of shunt DC motors
c. Operation of compound DC motors

INSTRUCTIONAL MATERIALS

Textbooks:

a. Timble and Willson
b. Rosenberg
c. Croft-Carr-Watt
d. Duff

A/Vs:

Bergwall Productions, Inc., filmstrips/cassettes, #810, "Rotary Machinery Explained-Direct Current Motors"

Student Manuals:

a. Hampden
b. Standard Electric Time
c. Bulletin
c. Georgia, Industrial Electricity, Industrial Wiring, Units IW-45, IW-46 and IW-47

Tools and Equipment:

a. Shop tools
b. Series DC motor
c. Shunt DC motor

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CLASSROOM HOURS 8

EVALUATION (IW-26)

Given the required rotating machinery and control components, the necessary test equipment and power supplies, the student will accurately hook-up and operate series, shunt and compound wound DC motors; determine the following characteristics of the motor: torque, start amps, full loads amps, speed and efficiency; and make a comparison of these three DC motors.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

d. Compound DC motor
e. Loads for motors
f. Power supply
g. Meter VOM

TASK

IW-27 Operating and checking load characteristics of DC generators

PERFORMANCE OBJECTIVE

Hook up, operate and check load characteristic of series, shunt and compound DC generators using resistance and inductive loads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. DC generators
   1. Series
   2. Shunt
   3. Compound
b. Compound
c. Operation and hook-up
d. Voltage and current capabilities
e. Rotation
f. RPM
g. Driver

Provide Demonstration On:

How to hook up and test series, shunt and compound generators

Provide Practical Application On:

a. Hook-up and operation of series generators
b. Hook-up and operation of shunt generators
c. Hook-up and operation of compound generators
d. Volt amp output of each generator
e. Types of load for each generator

INSTRUCTIONAL MATERIALS

Textbooks:

a. Duff
b. Adams

Student Manuals:

a. Hampden
b. Standard Electric Time Bulletin
c. Georgia, Industrial Electricity, Industrial Wiring, Units IW-48, IW-49 and IW-50

Tools and Equipment:

a. Shop tools
b. Motor generator set
c. Meter VOM
d. DC amp meter
e. Resistive load
f. Inductive load
g. Power supply

CLASSROOM HOURS 10

EVALUATION (IW-27)

Given the required rotating machinery and control components, the necessary test equipment and power supplies, the student will accurately hook-up, operate and test series, shunt and compound generator for maximum output with the proper load (resistive or inductive). Each test should include: Operation at

1. Below rated volts
2. Above rated volts
3. Below rated speed
4. Above rated speed

TASK

IW-28 Correcting power factor

PERFORMANCE OBJECTIVE

Improve the power factor of a single phase motor to 85%.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Power factor
b. Power factor improvement
c. Inductance
d. Capacitance
e. Reactance

Provide Demonstration On:

Power factor calculation techniques

Provide Practical Application On:

Power factor correction

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Adams

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-51

Tools and Equipment:

a. Shop tools
b. Assorted run capacitor
c. Meters VOM
d. Motor
e. AC-amp-meter
f. Watt meter
g. Power supply

CLASSROOM HOURS 10

EVALUATION (IW-28)

Given a single phase 115v induction motor with a low power factor, the necessary test equipment and power supplies, the student will accurately complete the necessary calculations to determine the correct MFD of a capacitor to improve the motor power factor by 85%; install the capacitor and operate the motor; and complete the following test: start amps, run amps, torque and speed.

TASK

IW-29 Hooking up and operating gear motors

PERFORMANCE OBJECTIVE

Hook-up and operate through a full speed range - belt driven and gear driven gear motors

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor
b. Reduction gears
c. Gear drives
d. Belt drives
e. Speed ratio
f. Variable speed drives

Provide Demonstration On:

Hooking up and operating belt and gear driven motors

Provide Practical Application On:

a. Operation of gear drives
b. Operation of belt drives
c. Operation of gear motors

INSTRUCTIONAL MATERIALS

Textbooks:

Croft-Carr-Watt

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-52

Tools and Equipment:

a. Shop tools
b. Gear motors drives
c. Power supply
d. Meter VOM
e. A/C amp meter

CLASSROOM HOURS 10

EVALUATION (IW-29)

Given a variable speed belt driven gear drive and a variable speed reduction gear drive, along with the necessary test equipment and control components, the student will make the required electrical and mechanical connections and operate each drive through a full speed range.

TASK

IW-30 Selecting correct machine drive

PERFORMANCE OBJECTIVE

Select the correct method of machine drive.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motors
b. Drive couplings
c. Ratio of pulleys
d. Speeds of machine drives
e. Shaft sizes

Provide Demonstration On:

Techniques for selecting proper motor drive

Provide Practical Application On:

a. Belt drives
b. Chain drives
c. Direct drives

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. AAVIM, Electric Motor Drives

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-53

Tools and Equipment:

a. Shop tools
b. Motor
c. Pulleys
d. Sprockets
e. Shafts
f. Meter VOM
g. Strobotach
h. Machine specs

CLASSROOM HOURS

10

EVALUATION (IW-30)

Given a machine drive application, the student will complete the necessary calculations to determine the correct motor drive method; select the motor to be installed; and specify hp, volts, rpm, for coupling the motor to drive using each of the following methods:

1. Direct shaft coupling
2. Belt drive - size of pulleys, belt size and number
3. Chain drive - sprocket size, teeth per inch and chain size

All material and equipment must meet manufacturer's installation recommendations.

TASK

IW-31 Installing ventilator fans

PERFORMANCE OBJECTIVE

Install and operate a ventilator fan and controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motors
b. Fans
c. Ventilation
d. CFM
e. Cubic measure
f. Fan control

Provide Demonstration On:

a. How to install controls for a ventilator fan
b. Determining ventilating requirements
c. Selecting motors to drive fans

Provide Practical Application On:

a. Motor types and installation
b. Fan location
c. Fan drives
d. Control of fans

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. AAVIM, Electric Motors
c. Althouse-Turnquist-Bracciano

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Units IW-54 and IW-56

Tools and Equipment:

a. Shop tools
b. Fan specs
c. CFM specs
d. Strobotach
e. Power supply
f. Print

CLASSROOM HOURS 10

EVALUATION (IW-31)

Given the requirements for a small building in terms of CFM air removal, and the necessary test equipment and material, the student will accurately select and install the controls for the correct size and type ventilator fan. All work must meet local and national code standards.

TASK

IW-32 Identifying motor leads

PERFORMANCE OBJECTIVE

Identify the unmarked leads of motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motors (splitphase, capacitors, R.I., 3-phase)
b. Each motor winding type
c. Lead identification
d. Lead marking procedure
e. Lead connection of each
f. Line connection of each
g. Motor voltage of each

Provide Demonstration On:

a. Motor winding types
b. Single volts motors
c. Dual volts motor
d. 3-phase dual volts motor

Provide Practical Application On:

a. Lead identification of single phase motors
b. Lead identification of three phase motors

INSTRUCTIONAL MATERIALS

Textbooks:

a. Rosenberg
b. Veinott

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Units IW-57, IW-58, IW-59 and IW-60

Tools and Equipment:

a. Shop tools
b. Power supplies
c. Meter VOM
d. A/C amp meter
e. Power supplies
f. 1 phase single volts motor

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CLASSROOM HOURS 8

EVALUATION (IW-32)

Given a single phase induction motor with four unmarked leads, a single phase induction motor with six unmarked leads, and three phase Wye or Delta wound induction motor with nine unmarked leads, the necessary test equipment and power supplies, the student will correctly identify the leads of each motor; make the correct motor lead connection, and the correct wiring connection to the proper power supply; and operate the motor and check for proper rpm, and no load amps and direction of rotation.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

g. 1 phase dual volt motor
h. 3 phase Delta wound motor
i. 3 phase Wye wound motor
j. Strobotach

TASK

IW-33 Identifying hazardous wiring locations

PERFORMANCE OBJECTIVE

Install wiring in hazardous locations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hazardous locations
b. Wiring methods
c. Sealing conduits

Provide Demonstration On:

Special techniques for installing wiring in hazardous locations

Provide Practical Application On:

Installing wiring under simulated hazardous conditions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Croft-Carr-Watt
b. Summers

A/Vs:

Career Aids, Inc., filmstrip/cassette, #LX60, "Electrical Safety in the Shop"

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-61

Tools and Equipment:

a. NEC
b. Shop tools
c. Set of prints
d. Material catalog

CLASSROOM HOURS 6

EVALUATION (IW-33)

Given a complete set of prints for a gasoline dispensing station having a grease pit, the student will accurately classify each area of the unit as to class location and specify the wiring method to be installed. Select the material to be installed according to local and national code standards.

TASK

IW-34 Operating a power actuated tool

PERFORMANCE OBJECTIVE

Operate correctly and safely a power actuated tool.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Conduit installation
b. Correct operation of power actuated tools

Provide Demonstration On:

Proper use of a power actuated tool

Provide Practical Application On:

Using a Ramset power actuated tool

INSTRUCTIONAL MATERIALS

Textbooks:

a. NEC
b. Operating instructions of fastening tool

Student Manuals:

Georgia, Industrial Electricity, Industrial Wiring, Unit IW-62

Tools and Equipment:

a. Ramset tools
b. Material
c. Conduit
d. Straps
e. Surface to fasten to

CLASSROOM HOURS 8

EVALUATION (IW-34)

Given a power actuated fastening tool, the proper instructions and material, the student will accurately fasten 1/2" EMT conduit to steel framing, and to a masonry wall.

SECTION VI

REFERENCES, RESOURCES

RESOURCES

Instructional Resource Matrix

The Instructional Resource Matrix lists the instructional resources required to carry out the learning activities in each unit in the program. The resources are divided into the categories of audio visuals, textbooks and student materials.

Audio visuals are identified by the following symbols: slide/tapes (ST) and filmstrips (FS).

Textbooks are identified by the author(s) and title.

Student Materials are identified by the supplier and title.

Textbook List

This list identifies the textbooks referenced in the Unit Guide section and on the Instructional Resource Matrix.

Audio Visuals

The suppliers of the audio visuals referenced on the Unit Guides and the Instructional Resource Matrix are listed.

Student Materials

The suppliers of the student manuals referenced on the Unit Guides and the Instructional Resource Matrix are listed.

Additional Instructional Resources

This section lists instructional resources which may be used in addition to those primary resources listed on the Unit Guides. The resources are divided into the categories of textbooks and audio visuals.

Resource Addresses

Addresses of instructional materials referenced on the Unit Guides and in the Additional Instructional Resources section are given.

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
RW-01 Identifying basic electrical theory	Georgia: EL-01, Understanding Basic Electrical Theory" (ST)	AAVIM: Electrical Wiring; AAVIM: Understanding Electricity and Electrical Terms; Alerich: Electrical Construction Wiring	Georgia: Industrial Electricity, Residential Wiring, Units RW-1a and RW-7a; Electricity: Post Secondary, Unit EL-01; Construction Cluster, Basic Electrical Theory, Units BET-1 through BET-10
RW-02 Installing a single 115 volt duplex outlet	Georgia: REW-01a, "Installing Convenience Outlets"; W-22, "115 Volt Outlet" (STO)	Mix: House Wiring Simplified; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit VO-1; Residential Electrical Wiring: Secondary, Unit REW-01
RE-03 Wiring multiple convenience outlets	Georgia: REW-02a, "Installing Convenience Outlets" (ST)	Mix: House Wiring Simplified; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit VO-2; Residential Electrical Wiring: Secondary, Unit REW-02
RW-04 Wiring a switch controlled convenience outlet	Georgia: REW-03a, "Installing Lighting Outlets"; W-23, "Switched Outlets" (ST)	AAVIM: Electrical Wiring; Alerich: Electrical Construction Wiring; Mix: House Wiring Simplified	Georgia: Construction Cluster, Unit VO-3; Residential Electrical Wiring: Secondary, Unit REW-03a; Electricity: Residential Wiring, Unit RW-1
RW-05 Installing three-wire branch circuits		NEC Handbook; AAVIM: Electrical Wiring	Georgia: Industrial Electricity: Residential Wiring, Units RW-13, RW-14 and RW-15; Industrial Electricity: NEC Handbook, Units NEC-6 and NEC-48

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
RW-06	Identifying code requirements for small appliance circuit		NEC Handbook; AAVIM: Electrical Wiring	Georgia: Industrial Electricity: Residential Wiring, Unit RW-12
RW-07	Installing split switched receptacles	Georgia: REW-04a, "Installing Split and Switched Receptacles" (ST)	AAVIM: Electrical Wiring; Merich: Electrical Construction Wiring; Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Residential Electrical Wiring: Secondary, Unit REW-04
RW-08	Installing a circuit with four receptacles and one single pole switch	Georgia: W-24, "Single Pole Switches" (ST)	NEC Handbook	Georgia: Industrial Electricity: Residential Wiring, Units RW-7 and RW-8; Industrial Electricity: NEC Handbook, Units NEC-5 and NEC-6
RW-09	Installing five receptacles on a split circuit		AAVIM: Electrical Wiring	Georgia: Industrial Electricity: Residential Wiring, Unit RW-9
RW-10	Wiring one light with a single pole switch and one outlet	Georgia: W-25, "Light with a Single Pole Switch and an Outlet that Is Always Hot" (ST)	Mix: House Wiring Simplified; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Units OL-1 and OL-2a
RW-11	Wiring a lighting circuit with a single pole switch	Georgia: W-24, "Single Pole Switches" (ST)	Mullin: Electrical Wiring - Residential; AAVIM: Maintaining the Lighting and Wiring System	Georgia: Construction Cluster, Unit OL-1

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
RW-12	Wiring two lights with a single pole switch	Georgia: W-25, "Light with a Single Pole Switch and an Outlet that Is Always Hot"; (ST) REW-03a, "Installing Lighting Outlets" (ST)	Mix: House Wiring Simplified; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Units OL-1 and OL-2a
RW-13	Wiring two three-way switches	Georgia: W-26, "Three-Way Switch": (ST) REW-06a, "Installing a Three-Way Switch" (ST)	Mullin: Electrical Wiring - Residential; AAVIM: Maintaining the Lighting and Wiring System; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit OL-3; Residential Electrical Wiring: Secondary, Unit REW-06; Industrial Electricity: Residential Wiring, Unit RW-4
RW-14	Wiring two three-way switches with two lights	Georgia: W-27, "Three-Way Switch with More Than One Light" (ST)	AAVIM: Electrical Wiring; Mullin: Electrical Wiring - Residential	Georgia: Construction Cluster, Unit OL-4
RW-15	Wiring a four-way switch which controls on light	Georgia: W-28, "Four-Way Switch" (ST)	Mullin: Electrical Wiring - Residential; AAVIM: Maintaining the Wiring and Lighting System; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit OL-5; Industrial Electricity: Residential Wiring, Units RW-5 and RW-6
RW-16	Wiring a master switch	Georgia: W-29, "Master Switch" (ST)	Mix: House Wiring Simplified; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit OL-6

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
RW-17	Wiring light fixtures	Georgia: REW-12a, "Identifying Residential Wiring Symbols and Designing Circuits" (ST)	AAVIM: Electrical Wiring; Alerich: Electrical Construction Wiring	Georgia: Residential Electrical Wiring: Secondary, Units REW-11 and REW-12; Industrial Electricity: Residential Wiring, Unit RW-16a
RW-18	Hanging light fixtures		AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit BPR-2; Industrial Electricity: Residential Wiring, Unit RW-32
RW-19	Identifying electrical symbols	Georgia: W-37, "Wiring Fixtures" (ST)	AAVIM: Electrical Wiring; Mullin: Electrical Wiring - Residential; Alerich: Electrical Construction Wiring	Georgia: Construction Cluster, Unit LF-1
RW-20	Installing electrical symbols into a floor plan and estimating materials	Georgia: W-38, "Hanging Fixtures" (ST)	Alerich: Electrical Construction Wiring; Mullin: Electrical Wiring - Residential; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit LF-2
RW-21	Identifying principles and applications of transformers		Alerich: Electrical Construction Wiring; Mullin: Electrical Wiring - Residential	Georgia: Industrial Electricity: Residential Wiring, Units RW-27a and RW-27a-1

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
RW-22	Wiring a low voltage transformer	Georgia: W-39, "Transformers" (ST)	Mullin: Electrical Wiring - Residential; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit LV-1
RW-23	Installing a push button switch	Georgia: W-40, "Push Button Switches" (ST)	Mullin: Electrical Wiring - Residential; Mix: House Wiring Simplified; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit LV-2
RW-24	Installing bells and chimes	Georgia: W-41, "Bells and Chimes" (ST); REW-05a, "Installing a Door Bell Circuit" (ST)	Mullin: Electrical Wiring - Residential; Mix: House Wiring Simplified; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit LV-3; Residential Electrical Wiring: Secondary, Unit REW-05; Industrial Electricity: Residential Wiring, Unit RW-23
RW-25	Wiring special low voltage circuits		Alerich: Electrical Construction Wiring	Georgia: Industrial Electricity: Residential Wiring, Units RW-24, RW-25 and RW-26
RW-26	Connecting 220 volt grounded outlets	Georgia: W-19, "220 Volt Grounded Outlets" (ST); REW-07a, "Installing 230v Circuits and Outlets" (ST)	Mullin: Electrical Wiring - Residential; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit GC-1; Residential Electrical Wiring: Secondary, Unit REW-07

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
RW-27	Wiring a hot water heater	Georgia: W-20, "Electric Hot Water Heater" (ST)	Mullin: Electrical Wiring-Residential; AAVIM: Electrical Wiring; NEC Handbook	Georgia: Construction Cluster, Unit GC-2; Industrial Electricity: Residential Wiring, Units RW-14 and RW 22
RW-28	Wiring ranges	Georgia: W-21, "Ranges" (ST): MA-01a, "Installing Electric Ranges" (ST)	Mullin: Electrical Wiring - Residential; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit GC-3; Industrial Electricity: Residential Wiring, Unit RW-16 and RW-17
RW-29	Wiring baseboard-type wall heaters	Georgia: W-30, "Wall Heaters" (ST)	Mullin: Electrical Wiring - Residential	Georgia: Construction Cluster, Unit H-1; Industrial Electricity: Residential Wiring, Unit RW-18
RW-30	Installing a 230 volt central heating or cooling circuit and disconnect		NEC Handbook; AAVIM: Electrical Wiring	Georgia: Industrial Electricity: Residential Wiring, Units RW-19 and RW-20
RW-31	Calculating loads		NEC Handbook; AAVIM: Electrical Wiring	Georgia: Industrial Electricity: Residential Wiring, Units RW-13a, RW-13a-1 and RW-28
RW-32	Calculating wire size and voltage drop		NEC Handbook; AAVIM: Electrical Wiring; Alerich: Electrical Construction Wiring	Georgia: Industrial Electricity: Residential Wiring, Units RW-13b and RW-20a
RW-33	Making calculations for three-way branch circuits		AAVIM: Electrical Wiring; Mullin: Electrical Wiring - Residential; NEC Handbook	Georgia: Industrial Electricity: Residential Wiring, Unit RW-10a; Industrial Electricity: NEC Handbook, Unit NEC-4

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
RW-34	Selecting conduit for service entrance	Georgia: REW-08b, "Installing Service Entrance" (ST); W-4, "Mast" (ST); W-34, "Thin-wall Conduit" (ST); W-35, "Rigid Conduit" (ST); W-36, "Supporting Conduit" (ST)	AAVIM: Electrical Wiring; Mullin: Electrical Wiring-Residential	Georgia: Construction Cluster, Units TE-4, C-1 and C-4
RW-35	Installing an electrical service entrance for single-phase power	Georgia: REW-08a, REW-08b and REW-08c, "Installing Service Entrance" (ST); W-1, "Power Outlet Box" (ST); W-12, "Layout of the Service Entrance" (ST); W-14, "Roof Boots" (ST); W-15, "Conductors" (ST); W-16, "Fish Tapes" (ST); W-18, "Grounding" (ST)	AAVIM: Electrical Wiring; Mullin: Electrical Wiring-Residential; Alerich: Electrical Construction Wiring; Mix: House Wiring Simplified	Georgia: Construction Cluster, Units SE-1 through SE-9; Residential Electrical Wiring: Secondary, Unit REW-08; Industrial Electricity: Residential Wiring, Unit RW-30
RW-36	Installing a circuit breaker box (or fuse box)	Georgia: W-8 "Circuit Breakers" (ST); W-9, "Fuses" (ST); W-31, "Electric Furnaces" (ST); W-32, "Thermostats" (ST); REW-09a, REW-09b, REW-09c and REW-09d, "Install Main Panel" (ST)	Mullin: Electrical Wiring-Residential; AAVIM: Maintaining the Wiring and Lighting System; AAVIM: Electrical Wiring; NEC Handbook	Georgia: Construction Cluster, Units SES-1, SES-2, EH-2 and EH-3; Industrial Electricity: Residential Wiring, Unit RW-29; Residential Electrical Wiring: Secondary, Unit REW-09

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
RW-37 Wiring a switch box	Georgia: W-10, "Service Entrance Wiring" (ST)	AAVIM: Electrical Wiring; Mullin: Electrical Wiring - Residential; NEC Handbook	Georgia: Construction Cluster, Unit SES-3
RW-38 Installing ground fault interruptors	Georgia: W-7, "Ground Fault Interruptor" (ST)	AAVIM: Maintaining the Lighting and Wiring System; AAVIM: Electrical Wiring	Georgia: Construction Cluster, Unit TE-7; Industrial Electricity: Residential Wiring, Unit RW-11a
RW-39 Installing a temporary service entrance	Georgia: W-1, "Power Outlet Box" (ST); W-2, "Power Cut Off" (ST); W-3, "Meter Bases" (ST); W-4, "Mast" (ST); W-5, "Weatherheads" (ST); W-6, "Wire Sizes" (ST); W-7, "Ground Fault Interruptors" (ST); REW-10a, "Temporary Service" (ST)	Mullin: Electrical Wiring - Residential; AAVIM: Electrical Wiring; AAVIM: Maintaining the Lighting and Wiring System; NEC Handbook	Georgia: Construction Cluster, Units TE-1 through TE-7; Residential Electrical Wiring: Secondary, Unit REW-10

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
T-01	Determining transformer polarity	Bergwall Productions, Inc.: "Basic Electricity and Electronics Explained - Alternating Current" (FS)	Duff: Alternating Current Fundamentals; Westinghouse Maintenance Hints	
T-02	Connecting to and operating dual voltage single phase transformers	Bergwall Productions, Inc.: "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning - Part One" (FS)	Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin
T-03	Connecting single phase transformers in series	Bergwall Productions, Inc.: "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning - Part One" (FS)	Croft, Carr and Watt: American Electrician Handbook; Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin
T-04	Connecting single phase transformers in-parallel	Bergwall Productions, Inc.: "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning - Parts One and Two" (FS)	Croft, Carr and Watt: American Electrician Handbook; Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin

CURRICULUM AREA:

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
T-05	Determining the KVA rating of transformers - single phase	Bergwall Productions, Inc.: "Basic A. C. Electricity for Heat, Ventilation and Air Conditioning - Parts One and Two" (FS)	Croft, Carr and Watt: American Electrician Handbook; Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers; Manufacturer's Catalog	
T-06	Determining the KVA rating of transformers - three phase	Bergwall Productions, Inc.: "Basic A. C. Electricity for Heat, Ventilation and Air Conditioning - Parts One and Two" (FS)	Croft, Carr and Watt: American Electrician Handbook; Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers; Manufacturer's Catalog	Standard Electric Time Bulletin
T-07	Hooking up and operating a one phase auto transformer	Long Filmslide Service: "Transformers" (FS)	Croft, Carr and Watt: American Electrician Handbook; Duff: Alternating Current Fundamentals; Dunlap Siefert and Austin: Transformers	Standard Electric Time Bulletin

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
T-08	Hook-up a one phase buck booster transformer	Long Filmslide Service: "Transformers" (FS)	Croft, Carr and Watt: American Electrician Handbook; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin
T-09	Hooking up a three phase booster transformer	Long Filmslide Service: "Transformers" (FS)	Croft, Carr and Watt: American Electrician Handbook; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin
T-10	Hooking up a three phase auto transformer	Long Filmslide Service: "Transformers" (FS)	Croft, Carr and Watt: American Electrician Handbook; Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin
T-11	Hooking up a three phase transformer bank; Wye/Wye	Long Filmslide Service: "Transformers" (FS)	Duff: Alternating Current Fundamentals Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
T-12 Hooking up a three phase transformer bank; Delta/Delta	Long Filmslide Service: "Transformers" (FS)	Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin
T-13 Hooking up a three phase bank of transformers; open Delta	Long Filmslide Service: "Transformers" (FS)	Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin
T-14 Hooking up a three phase transformer bank; Wye/Delta	Long Filmslide Service: "Transformers" (FS)	Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin
T-15 Hooking up a three phase transformer bank; Delta/Wye	Long Filmslide Service: "Transformers" (FS)	Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
T-16	Hooking up a three phase transformer bank; reversed voltage	Long Filmslide Service: "Transformers" (FS)	Duff: Alternating Current Fundamentals; Dunlap, Siefert and Austin: Transformers	Standard Electric Time Bulletin
T-17	Hooking up transformers for special applications	Long Filmslide Service: "Transformers" (FS)	Duff: Alternating Current Fundamentals; Penden and Del-Mar: Electrical Engineer's Handbook; Dunlap, Siefert and Austin: Transformers; Croft, Carr and Watt: American Electrician Handbook	Standard Electric Time Bulletin

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
CW-01	Calculating service load for a small commercial building	Bergwall Productions, Inc.: "Planning and Roughing In" (FS)	Ramsey and Sleeper: Architectural Graphic Standard; Croft, Carr and Watt: American Electrician's Handbook; Summers: National Electrical Code; Heine, Dunlap and Jones: Electrical Blueprints	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-1
CW-02	Locating service entrance equipment and writing specifications	Singer Career Systems: "Electrical Wire and Cable" (FS); "Electrical Boxes" (FS); AAVIM: "Electrical Wiring Residential - Utility Buildings - Service Areas" (ST)	Ramsey and Sleeper: Architectural Graphic Standard; Graham: Industrial and Commercial Wiring; Summers: National Electrical Code	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-2
CW-03	Selecting service entrance conductor	AAVIM: "Electrical Wiring Residential - Utility Buildings - Service Areas" (ST)	Summers: National Electrical Code	Georgia: Industrial Electricity, Commercial Wiring, Units CW-3 and CW-3a

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
CW-04	Calculating service conduits	Singer Career Systems: "Electrical Service Entrance" (FS); AAVIM: "Electrical Wiring Residential - Utility Buildings - Service Areas" (ST)	Summers: National Electrical Code	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-3
CW-05	Installing service conduits	AAVIM: "Electrical Wiring Residential - Utility Buildings - Service Areas" (ST)	Summers: National Electrical Code	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-3a
CW-06	Installing service entrance conductors	Singer Career Systems: "Electrical Service Entrance" (FS); AAVIM: "Electrical Wiring Residential - Utility Buildings - Service Areas" (ST)	Summers: National Electrical Code	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-3a
CW-07	Selecting and installing meters	Singer Career Systems: "Reading Electric Meters" (FS)	Summers: National Electrical Code	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-4
CW-08	Selecting and installing panels		Summers: National Electrical Code	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-4

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
CW-09	Calculating and installing motor branch circuits		Rosenberg: Electric Motor Repair; Summers: National Electrical Code; Graham: Industrial and Commercial Wiring; Veinott: Horsepower Electric Motors; Croft, Carr and Watt: American Electrician Handbook	Square D Company: Square D Manual #368-R2
CW-10	Installing and operating subfeeders and panels		Summers: National Electrical Code; Croft, Carr and Watt: American Electrician's Handbook; Graham: Industrial and Commercial Wiring	
CW-11	Grouping outlets onto branch circuits	Singer Career Systems: "Installing Electrical Boxes and Conduits" (FS)	Croft, Carr and Watt: American Electrician's Handbook; Summers: National Electrical Code	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-5

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
CW-12	Installing specific purpose outlets	Bergwall Productions, Inc.: "Finishing the Installation" (FS)	Summers: National Electrical Code	
CW-13	Calculating branch circuit conductors and overcurrent protection	Singer Career Systems: "Circuit Breakers" (FS)	Summers: National Electrical Code; Croft, Carr and Watt: American Electrician's Handbook	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-5
CW-14	Installing branch circuits and controls for lighting	Bergwall Productions, Inc.: "Planning and Roughing In" (FS)	Graham: Industrial and Commercial Wiring; Summers: National Electrical Code; Croft, Carr and Watt: American Electrician's Handbook	
CW-15	Selecting conduit		Summers: National Electrical Code	Georgia: Industrial Electricity, Commercial Wiring, Unit CW-6

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
CW-16 Installing conduit under a concrete slab		Summers: National Electrical Code; Croft, Carr and Watt: American Electrician's Handbook; Graham: Industrial and Commercial Wiring	
CW-17 Installing outlet, junction and conduitlets		Croft, Carr and Watt: American Electrician's Handbook; Graham: Industrial and Commercial Wiring; Summers: National Electrical Code	

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
CW-18	Installing branch circuits and controls for air conditioning and heating	Bergwall Productions, Inc: "Basic A.C. Electricity for Heat, Ventilation and Air Conditioning - Part One" (FS)	Summers: National Electrical Code; Croft, Carr and Watt: American Electrician's Handbook; Graham: Industrial and Commercial Wiring; Althouse, Turnquist and Bracciano: Modern Refrigeration and Air Conditioning	
CW-19	Selecting and installing branch circuits for three phase water heaters	Bergwall Productions, Inc.: "Finishing the Installation" (FS)	Summers: National Electrical Code; Croft, Carr and Watt: American Electrician's Handbook; Graham: Industrial and Commercial Wiring; Manufacturer's catalog	

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
IW-01 Planning and performing site work for a small industrial facility	Bergwall Productions, Inc.: "Planning and Roughing In" (FS)	Croft, Carr and Watt: American Electrician's Handbook; Graham: Industrial and Commerical Wiring; Summers: National Electrical Code	
IW-02 Making calculations for electric motors, welders and heaters	Hobar Publications: "Electric Motors: Enclosures, Bearings and Mountings" (ST)	Summers: National Electrical Code	
IW-03 Calculating the 120 and 277 volt lighting load	Hobar Publications: "Wiring a Switch and Lamp" (ST)	Croft, Carr and Watt: American Electrician's Handbook; Graham: Industrial and Commercial Wiring; Summers: National Electrical Code; Manufacturer's catalogs	
IW-04 Calculating and selecting receptacles for 120/208 volt loads		Graham: Industrial and Commercial Wiring; Summers: National Electrical Code	

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
IW-05	Calculating size for and selecting and installing a Buss-Duct		Croft, Carr and Watt: American Electrician's Handbook; Graham: Industrial and Commercial Wiring; Summers: National Electrical Code; Manufacturer's catalogs	
IW-06	Selecting and installing a 3 phase, 4 wire, 480v panel	Hobar Publications: "Electrical Connections and Current Control" (ST)	Adams: Electrical Principle and Practices; Croft, Carr and Watt: American Electrician's Handbook; Hubert: Operational Electricity; Summers: National Electrical Code	
IW-07	Selecting the correct transformer bank		Summers: National Electrical Code; Manufacturer's catalog	
IW-08	Selecting and installing a 480v/208-120 3 phase, 4 wire service		Croft, Carr and Watt: American Electrician's Handbook; Supply catalogs	

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
IW-09	Installing metering equipment		Summers: National Electrical Code; Croft, Carr and Watt: American Electrician's Handbook; Hubert: Operational Electricity; Local codes	Georgia: Industrial Electricity: Industrial Wiring, Units IW-6 and IW-7
IW-10	Selecting and installing panels and selecting distribution equipment		Summers: National Electrical Code; Adams: Electrical Principles and Practices; Hubert: Operational Electricity; Manufacturer's catalogs	Georgia: Industrial Electricity: Industrial Wiring, Unit IW-12
IW-11	Selecting and installing a 277v fluorescent light	Bergwall Productions, Inc.: "Finishing the Installation" (FS), "Low Voltage and Special Circuits" (FS)	Croft, Carr and Watt: American Electrician's Handbook; Graham: Industrial and Commercial Wiring; Fixture catalog	Georgia: Industrial Electricity: Industrial Wiring, Unit IW-13

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
IW-12	Determining sizes and types of feeders and overcurrent protection devices	Hobar Publications: "Electrical Connections and Current Control" (ST)	Summers: National Electrical Code; Croft, Carr and Watt: American Electrician's Handbook	Georgia: Industrial Electricity: Industrial Wiring, Unit CW-16
IW-13	Installing a branch circuit for welders		Croft, Carr and Watt: American Electrician's Handbook; Van Vaulkenburgh: Basic Industrial Electricity; Summers: National Electrical Code	Georgia: Industrial Electricity: Industrial Wiring, Unit IW-19
IW-14	Operating a split phase motor	AAVIM: "How Electric Motors Start and Run" (ST)	Veinott: Fractional and Subfractional Horsepower Electric Motors; Rosenberg: Electric Motor Repair; Croft, Carr and Watt: American Electrician's Handbook	Hampden; Georgia: Industrial Electricity: Industrial Wiring, Unit IW-20

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
IW-15 Operating a capacitor start motor	AAVIM: "How Electric Motors Start and Run" (ST)	Veinott: Fractional and Subfractional Horsepower Electric Motors; Rosenberg: Electric Motor Repair; Croft, Carr and Watt: American Electrician's Handbook	Hampden; Georgia: Industrial Electricity: Industrial Wiring, Unit IW-22
IW-16 Operating a universal motor	AAVIM: "How Electric Motors Start and Run" (ST)	Veinott: Fractional and Subfractional Horsepower Electric Motors; Rosenberg: Electric Motor Repair; Adams: Electrical Principles and Practices	Georgia: Industrial Electricity: Industrial Wiring, Unit IW-25
IW-17 Operating a 3 phase induction motor	AAVIM: "How Electric Motors Start and Run" (ST)	Veinott: Fractional and Subfractional Horsepower Electric Motors; Rosenberg: Electric Motor Repair; Adams: Electrical Principles and Practices	Georgia: Industrial Electricity: Industrial Wiring, Unit IW-27

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
IW-18 Operating a 3 phase synchronous motor	AAVIM: "How Electric Motors Start and Run" (ST)	Adams: *Electrical Principles and Practices*; Croft, Carr and Watt: *American Electrician's Handbook*	Hampden; Georgia: *Industrial Electricity: Industrial Wiring*, Unit IW-29
IW-19 Operating a 3 phase, 1 winding, 2 speed motor	AAVIM: "How Electric Motors Start and Run" (ST)	Hubert: *Operational Electricity*; Siskind: *Electrical Circuits*; Rosenberg: *Electric Motor Repair*; Siskind: *Electrical Control Systems in Industry*	Hampden
IW-20 Operating a 3 phase, 2 winding, 2 speed motor	AAVIM: "How Electric Motors Start and Run" (ST)	Hubert: *Operational Electricity*; Siskind: *Electrical Circuits*; Rosenberg: *Electric Motor Repair*; Siskind: *Electrical Control Systems in Industry*	Hampden; Georgia: Industrial Electricity: Industrial Wiring, Unit IW-31

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
IW-21 Operating single and three phase alternators		Adams: Electrical Principles and Practices; Timble and Willson: Industrial Electricity; Siskind: Electrical Circuits; Duff: Alternating Current Fundamentals; Siskind: Electrical Control Systems in Industry	Hampden; Standard Electric Time Bulletin; Georgia: Industrial Electricity: Industrial Wiring, Units IW-32 through IW-39
IW-22 Operating an induction regulator		Van Volkenburgh, Nooger and Neville: Basic Industial Electricity; Siskind: Electrical Circuits; Penden and DelMar: Electrical Engineer's Handbook; Siskind: Electrical Control Systems in Industry	Standard Electric Time Bulletin; Georgia: Industial Electricity: Industrial Wiring, Unit IW-41

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
IW-23	Operating a rotary frequency changer		Croft, Carr and Watt: American Electrician's Handbook; Siskind: Electrical Circuits; Siskind: Electrical Control Systems in Industry	Standard Electric Time Bulletin; Georgia: Industrial Electricity: Industrial Wiring, Unit IW-42
IW-24	Operating a synchronous rotary converter		Timble and Willson: Industrial Electricity; Croft, Carr and Watt: American Electrician's Handbook	Standard Electric Time Bulletin; Georgia: Industrial Electricity: Industrial Wiring, Unit IW-43
IW-25	Operating a rotary converter	Bergwall Productions, Inc.: "Rotary Machinery Explained - Direct Current Motors" (FS)	Penden and DelMar: Electrical Engineer's Handbook; Siskind: Electrical Circuits; Siskind: Electrical Control Systems in Industry	Standard Electric Time Bulletin; Georgia: Industrial Electricity: Industrial Wiring, Unit IW-44

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
IW-26 Operating DC motors	Bergwall Productions, Inc.: "Rotary Machinery Explained - Direct Current Motors"	Timble and Willson: Industrial Electricity; Rosenberg: Electric Motor Repair; Croft, Carr and Watt: American Electrician's Handbook; Duff: Alternating Current Fundamentals	Hampden; Standard Electric Time Bulletin; Georgia: Industrial Electricity: Industrial Wiring, Units IW-45, IW-46 and IW-47
IW-27 Operating and checking load characteristics		Duff: Alternating Current Fundamentals; Adams: Electrical Principles and Practices	Hampden; Standard Electric Time Bulletin; Georgia: Industial Electricity: Industrial Wiring, Units IW-48, IW-49 and IW-50
IW-28 Correcting power factor		Croft, Carr and Watt: American Electrician's Handbook; Adams: Electrical Principles and Practices	Georgia: Industiral Electricity: Industrial Wiring, Unit IW-51
IW-29 Hooking up and operating gear motors		Croft, Carr and Watt: American Electrician's Handbook	Georgia: Industiral Electricity: Industrial Wiring, Unit IW-52

CURRICULUM AREA: Industrial Electricity

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
IW-30	Selecting correct machine drive		Croft, Carr and Watt: American Electrician's Handbook; AAVIM: Electric Motor Drives	Georgia: Industrial Electricity: Industrial Wiring, Unit IW-53
IW-31	Installing ventilator fans		Croft, Carr and Watt: American Electrician's Handbook; AAVIM: Electric Motors; Althouse, Turnquist and Bracciano: Modern Refrigeration and Air Conditioning	Georgia: Industial Electricity: Industrial Wiring, Units IW-54 and IW-56
IW-32	Identifying motor leads		Rosenberg: Electric Motor Repair; Veinott: Fractional and Subfractional Horsepower Electric Motors	Georgia: Industrial Electricity: Industrial Wiring, Units IW-57, IW-58, IW-59 and IW-60
IW-33	Identifying hazardous wiring locations	Career Aids, Inc.: "Electrical Safety in the Shop" (FS)	Croft, Carr and Watt: American Electrician's Handbook; Summers: National Electrical Code	Georgia: Industrial Electricity: Industrial Wiring, Unit IW-61

CURRICULUM AREA: Industrial Electricity

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
IW-34 Operating a power actuated tool		Summers: *National Electrical Code*; Manufacturer's operator's manual	Georgia: *Industrial Electricity: Industrial Wiring*, Unit IW-62

TEXTBOOK LIST

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Althouse, A., Turnquist, C. and Bracciano, A., Modern Refrigeration and Air Conditioning. South Holland, IL: The Goodheart-Willcox Company Inc., 1975.

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AAVIM, Maintaining the Lighting and Wiring System. Athens, GA: American Association for Vocational Instructional Materials, 1980.

AAVIM, Understanding Electricity and Electrical Terms. Athens, GA: American Association for Vocational Instructional Materials, 1974.

Croft, T., Carr and Watt, American Electrician Handbook (9th ed). Boston, MA: McGraw-Hill Book Company, 1970.

Duff, J., Alternating Current Fundamentals (2nd ed). Albany, NY: Delmar Publishers, 1980.

Dunlap, Siefert and Austin, Transformers (9th ed). Chicago, IL: American Technical Society.

Graham, K. C., Industrial and Commercial Wiring (2nd ed). Chicago, IL: American Technical Society, 1963.

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Mix, F., House Wiring Simplified. South Holland, IL: The Goodheart-Willcox Company, Inc., 1973.

Mullin, R., Electrical Wiring-Residential (5th ed). Albany, NY: Delmar Publishers, 1975.

National Electrical Code, 1978. Boston, MA: National Fire Protection Association, 1977.

Pender, H. and Delmar, W., Electrical Engineer's Handbook (4th ed). Somerset, NJ: John Wiley and Sons, Inc.

Ramsey, C. and Sleeper, H., Architectural Graphic Standard (6th ed). Somerset, NJ: John Wiley and Sons, Inc.

Rosenberg, R., Electric Motor Repair (2nd ed). New York, NY: Holt, Rinehart and Winston.

Siskind, C., Electrical Circuits. Boston, MA: McGraw-Hill Book Company, 1965.

Siskind, C., Electrical Control Systems in Industry. Boston, MA: McGraw-Hill Book Company, 1963.

Smith, R., Electricty for Refrigeration, Heating and Air Conditioning. North Scituate, MA: Duxbury Press, 1978.

Summers, W., National Electrical Code. Boston, MA: National Fire Protection Association, 1981.

Timble, W. and Willson, F., Industrial Electricity (5th ed). Somerset, NJ: John Wiley and Sons, Inc., 1963.

Van Valkenburgh, Basic Industrial Electricity (2 vols). New York, NY: Nooger and Neville, Inc., 1962.

Veinott, C., Fractional and Subfractional-Horsepower Electric Motors (3rd ed). Boston, MA: McGraw-Hill Book Company, 1970.

Westinghouse Maintenance Hints. New York, NY: Westinghouse Learning Corporation.

STUDENT MATERIALS

Georgia*, Construction Cluster, Residential Wiring, Student Manual. Atlanta, GA: Georgia Department of Education, 1976.

Georgia*, Industrial Electricity, Commercial Wiring, Student Manual. Atlanta, GA: Georgia Department of Education, 1976.

Georgia*, Industrial Electricity, Industrial Wiring, Student Manual. Atlanta, GA: Georgia Department of Education, 1976.

Georgia*, Industrial Electricity, Residential Wiring, Student Manual. Atlanta, GA: Georgia Department of Education, 1976.

Hampden Manual. East Longmeadow, MA: Hampden Engineering Corporation.

*Available from Vocational Education Materials Center, University of Georgia (See Resource Addresses).

Square D Manual. Palatine, IL: Square D Company.

Standard Electric Time Bulletin. Springfield, MA: Standard Electric Time Company.

AUDIO VISUALS

AAVIM	Slide/Tapes
Bergwall Productions, Inc.	Filmstrips
Career Aids, Inc.	Filmstrips
Georgia Department of Education*	Slide/Tapes
Hobar Publications	Slide/Tapes
Long Filmslide Service	Filmstrips
Singer Career Systems	Filmstrips

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*Available from Vocational Education Materials Center, University of Georgia (See Resource Addresses).

ADDITIONAL INSTRUCTIONAL RESOURCES

Textbooks

Alerich, W., Electricty 4-AC Motors and Generators, Controls, Alternators (3rd ed.). Albany, NY: Delmar Publishers, 1980.

Alerich, W., Electricity 3-DC Motors and Generators, Controls, Transformers (3rd ed). Albany, NY: Delmar Publishers, 1980.

Alerich, W., Electric Motor Control. Albany, NY: Delmar Publishers, 1975.

Anderson, E. P. and Miller, R., Electric Motors (3rd ed). Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1977.

Bell, D., Fundamentals of Electric Circuits (2nd ed). Reston, VA: Reston Publishing Company, 1981.

Lister, E., Electrical Circuits and Machines (5th ed). Boston, MA: McGraw-Hill Book Company, 1968.

Loper, O., Direct Current Fundamentals (2nd ed). Albany, NY: Delmar Publishers, 1978.

Middleton, R., Practical Electricity (3rd ed). Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1969.

Miller, R., Industrial Electricity. Peoria, IL: Bennett Publishing Company, 1981.

Mullin, R. and Smith, R., Electrical Wiring-Commercial. Albany, NY: Delmar Publishers, 1978.

Palmquist, R. E., House Wiring (4th ed). Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1978.

Patrick, D. R. and Fardo, S. W., Industrial Electrical Systems, Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1978.

Singer, B., Basic Mathematics for Electricity and Electronics (4th ed). Boston, MA: McGraw-Hill Book Company, 1978.

Siskind, C., DC and AC Electrical Machines (2nd ed.). Boston, MA: McGraw-Hill Book Company, 1959.

Steinberg, W. and Ford, W., Basic Electricity and Electronics (4th ed). Chicago, IL: American Technical Society, 1972.

Traister, J. E., Electrical Blueprint Reading. Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1975.

Audio Visuals

A. J. Nystrom and Co.	Transparencies
Animated Electronic Films	Super 8mm loop
Association Films, Inc.	16mm reel
Bailey-Film Associates	Super 8mm loop
CCM School Materials, Inc.	Transparencies
CENCO Educational Aids	8mm loop/transparencies
Coronet Films	16mm reel
Creative Visuals	Transparencies
Curriculum Materials Corp.	Filmstrips
DCA Educational Products, Inc.	Transparencies
Encyclopedia Britannica Educational Corp.	16mm reel
Eye Gate House, Inc.	Transparencies
GAF Corporation Reprographic Products	Transparencies
George F. Cram Company, Inc.	Transparencies
Hank Newenhouse/Novo	16mm reel
Indiana University Audio Visual Center	16mm reel
Jam Handy School Service, Inc.	Filmstrips/super 8mm loop
Long Filmslide Service	Filmstrips
McGraw-Hill Films	Filmstrips/transparencies
NASCO	Filmstrips/transparencies
Popular Science Publishing Co.	Filmstrips/transparencies
Rand McNally and Co.	8mm loop
Schoolmasters Science	8mm loop
Serina Press	16mm reel

Society for Visual Education, Inc.	Filmstrips
Stansi Scientific Division	Transparencies
Sterling Educational Films	8mm loop
3 M Company	Transparencies
Tweedy Transparencies	Transparencies
United States National Audio Visual Center	16mm reel
United Transparencies, Inc.	Transparencies
Universal Education and Visual Arts	16mm reel

RESOURCE ADDRESSES

A.J. Nystrom and Company
3333 Elston Avenue
Chicago, IL 60618

AAVIM (American Association for Vocational Instructional Materials)
120 Engineering Center
Athens, GA 30602

American Technical Society
848 E. 58th Street
Chicago, IL 60637

Animated Electronic Films
P.O. Box 2036
Eads Station
Arlington, VA 22202

Association Films, Inc.
600 Madison Avenue
New York, NY 10022

Bailey Film Associates
11559 Santa Monica Blvd.
West Los Angeles, CA 90025

Bennett Publishing Company
809 W. Detweiller Dr.
Dept. E 81
Peoria, IL 61615

Bergwall Productions, Inc.
839 Stewart Avenue
Garden City, NY 11530

Bobbs-Merrill Educational Publishing
4300 West 62nd Street
P.O. Box 7080
Indianapolis, IN 46206
(317) 298-5745

Career Aids, Inc.
8950 Lurline Avenue
Dept. T 76
Chatsworth, CA 91311
(213) 341-8200

CCM School Materials, Inc.
2124 West 82nd Place
Chicago, IL 60620

CENCO Educational Aids
2600 S. Kostner Avenue
Chicago, IL 60623

Coronet Films
65 E. South Water Street
Chicago, IL 60601

Creative Visuals
Box 1911
Big Spring, TX 79720

Curriculum Materials Corporation
1319 Vine Street
Philadelphia, PA 19109

DCA Educational Products, Inc.
4865 Stanton Avenue
Philadelphia, PA 19144

Delmar Publishers
P.O. Box 5087
Albany, NY 12205
(800) 325-6000

Duxbury Press
A Division of Wadsworth
Publishing Company, Inc.
Belmont, CA 94002

Encyclopedia Britannica Corporation
405 North Michigan Avenue
Chicago, IL 60611

Eye Gate House, Inc.
146-01 Archer Avenue
Jamaica, NY 11435

GAF Corporation Reprographic Products
140 West 51st Street
New York, NY 10020

George F. Cram Company, Inc.
School and Library Division
P.O. Box 426
Indianapolis, IN 46206

The Goodheart-Willcox Company
123 W. Taft Drive
South Holland, IL 60473

Hampden Engineering Corporation
Shaker Road
East Longmeadow, MA 01028

Henk Newenhouse/Novo
1825 Willow Road
Northfield, IL 60093

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112
(612) 633-3170

Holt, Rinehart and Winston
383 Madison Avenue
New York, NY 10017

Indiana University Audio Visual Center
Field Services Department
Bloomington, IL 47401

Jam Handy School Service, Inc.
2781 East Grand Blvd.
Detroit, MI 48211

John Wiley and Sons, Inc.
Eastern Distribution Center
1 Wiley Drive
Somerset, NJ 08873
(201) 469-4400

Long Filmslide Service
7505 Fairmont Avenue
El Cerrito, CA 94530

McGraw-Hill Book Company
607 Boylston Street
Boston, MA 02116

McGraw-Hill Films
8171 Redwood Hwy.
Novato, CA 94947

NASCO
Fort Atkinson, WI 53538

National Fire Protection Association
470 Atlantic Avenue
Boston, MA 02110

Nooger and Neville, Inc.
15 Maiden Lane
New York, NY 10038

Popular Science Publishing Company
Audio Visual Division
355 Lexington Avenue
New York, NY 10017

Rand McNally and Company
405 Park Avenue
New York, NY 10022

Reston Publishing Company
11480 Sunset Hills Road
Reston, VA 22090

Schoolmasters Science
745 State Circle
Ann Arbor, MI 48104

Serina Press
70 Kennedy Street
Alexandria, VA 22305

Singer Career Systems
80 Commerce Drive
Rochester, NY 14623
(800) 828-7876

Society for Visual Education, Inc.
1345 Diversey Parkway
Chicago, IL 60614

Square D Company
Executive Plaza
Palatine, FL 60067

Standard Electric Time Company
89 Logan Street
Springfield, MA 01101
(413) 732-1141

Stansi Scientific Division
1231 North Honore Street
Chicago, IL 60622

Sterling Educational Films
241 East 34th Street
New York, NY 10016

3 M Company
Visual Products Division
St. Paul, MN 55101

Tweedy Transparencies
208 Hollywood Avenue
East Orange, NJ 07018

United States National Audio-visual Center
National Archives and Records Service
Washington, D.C. 20409

United Transparencies Inc.
P.O. Box 688
Binghamton, NY 13902

Universal Education and Visual Arts
221 Park Avenue South
New York, NY 10003

Vocational Education Materials Center
University of Georgia
Green Street
Athens, GA 30602

Westinghouse Learning Corporation
100 Park Avenue
New York, NY 10017

SECTION VII

STUDENT RECORDS

STUDENT RECORDS

This section contains four forms, the Individual Progress Report Chart, the Group Progress Chart, the Competency Checklist and the Certificate of Competency. The use of these Charts is described below and on page 6.

INDIVIDUAL PROGRESS REPORT

One copy should be kept in each student's confidential file and updated as tasks are completed. Grades should be assigned upon task completion and then averaged for grade reporting. Difficulty, excessive amounts of time, etc. should be noted on this form and should be discussed with the student.

GROUP PROGRESS CHART

This chart reflects task completion only and can be displayed in the classroom or lab area. Due to confidentiality of records, a grade must not be recorded. The instructor should maintain a copy of this record and update it daily.

INDIVIDUAL PROGRESS REPORT

NAME ________________________________

PROGRAM/ ____________________________ AREA ______________________________
CLUSTER

TASK/ UNIT NO.	UNIT TITLE	DATE STARTED	DATE COMP.	EST. TIME	GRADE

GROUP PROGRESS CHART

	UNITS/TASKS																				
NAME																					

COMPETENCY CHECKLIST

The Competency Checklist is an easy device for the instructor to use to know when a student is eligible to receive a Certificate of Competency (shown on page 9). One Checklist is used per student for as long as the student stays in the program. The instructor may use the checklist in the following manner:

1. Enter the student's name on the form.
2. As the student masters each task, check off the task under each job title on the Competency Checklist for which it appears.
3. Keep the Checklist in each student's personal file or keep all Competency Checklists together in a separate file.
4. When all the tasks underneath a job title have been checked off, the student is eligible to receive a Certificate of Competency for that job title.

CERTIFICATE OF COMPETENCY

The Certificate of Competency is issued by the instructor to certify that the student has mastered the tasks necessary for entry level employment for the job listed on the Certificate. The specific tasks that have been mastered are printed on the back of the Certificate, which can be used by the student to show a prospective employer exactly what the student is qualified to do. The Certificates should be printed ahead of time so that the instructor may simply fill in the front of the Certificate whenever a student is eligible to receive one, as indicated by the student's Competency Checklist. A sample completed Certificate of Competency appears on page 9 followed by a Certificate of Competency for each of the possible Industrial Electricity program exit points (job titles).

The Certificate should be completed by the instructor as follows:

1. Enter the student's name.
2. Enter the school name.
3. Date and sign the Certificate.
4. It is recommended that the Certificate be stamped with the school seal.

COMPETENCY CHECKLIST

STUDENT NAME

As the student masters each unit of instruction, check off the unit number under each of the following job titles where it appears. When all the units under a job title have been completed, the student is eligible to receive a Certificate of Competency for that job title.

Electrician's Helper

829.684-022

( ) RW-01
( ) RW-02
( ) RW-03
( ) RW-04
( ) RW-05
( ) RW-07
( ) RW-08
( ) RW-09
( ) RW-10
( ) RW-11
( ) RW-12
( ) RW-13
( ) RW-14
( ) RW-15
( ) RW-16
( ) RW-19
( ) RW-20
( ) RW-34
( ) RW-36
( ) RW-37
( ) RW-39
( ) T-02
( ) T-03
( ) T-04
( ) T-05
( ) T-06
( ) CW-03
( ) CW-04
( ) CW-05
( ) CW-06
( ) CW-07
( ) CW-08
( ) CW-09
( ) CW-11
( ) CW-12
( ) CW-13
( ) CW-14
( ) CW-15
( ) CW-17
( ) IW-14
( ) IW-15
( ) IW-16
( ) IW-17
( ) IW-19
( ) IW-20
( ) IW-31
( ) IW-32
( ) IW-33
( ) IW-34

Electrician

824.261-010

( ) RW-01
( ) RW-02
( ) RW-03
( ) RW-04
( ) RW-05
( ) RW-06
( ) RW-07
( ) RW-08
( ) RW-09
( ) RW-10
( ) RW-11
( ) RW-12
( ) RW-13
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( ) RW-38
( ) RW-39
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( ) T-17
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( ) CW-16
( ) CW-17
( ) CW-18
( ) CW-19
( ) IW-01
( ) IW-02
( ) IW-03
( ) IW-04
( ) IW-05
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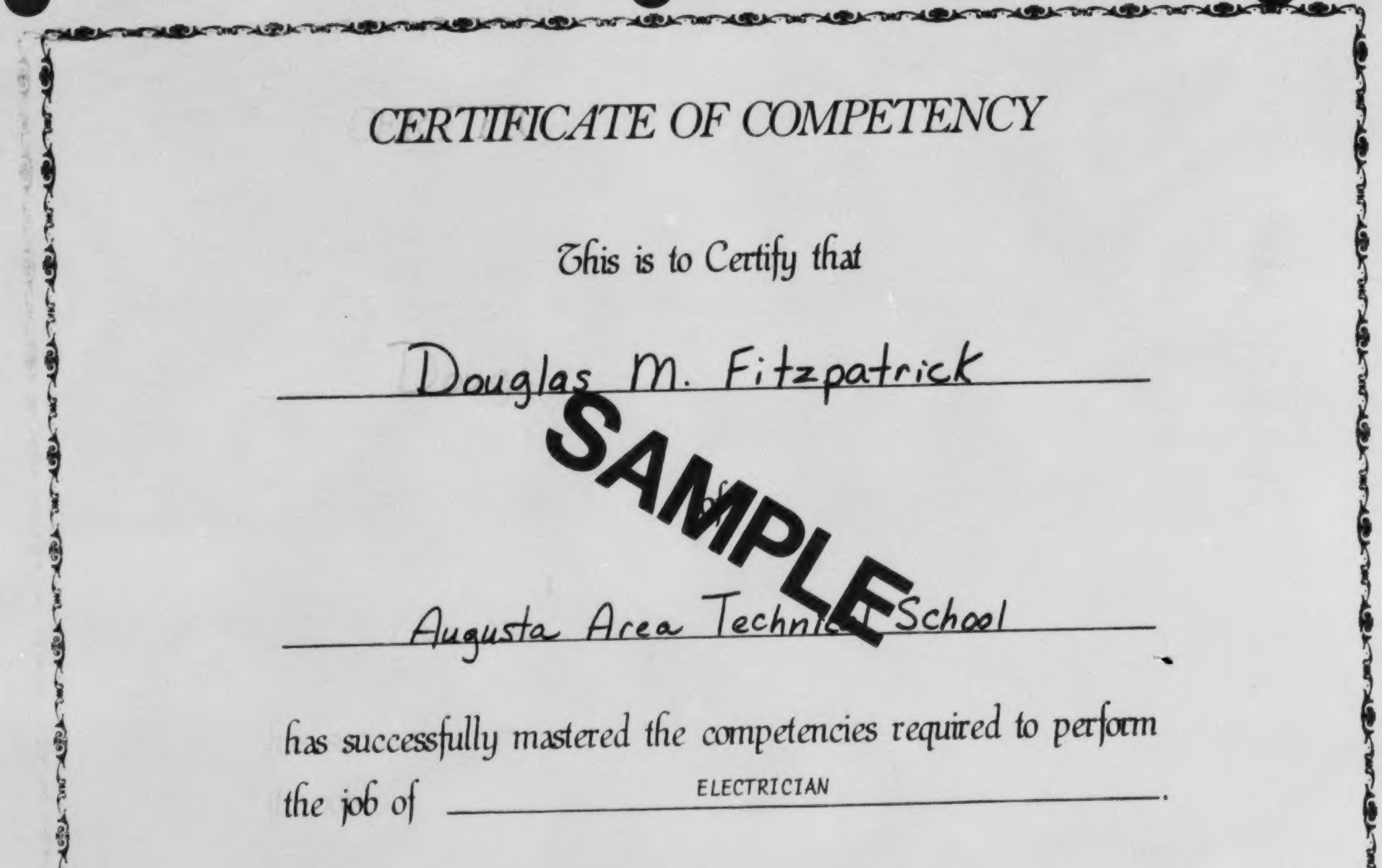
( ) IW-28
( ) IW-29
( ) IW-30
( ) IW-31
( ) IW-32
( ) IW-33
( ) IW-34



CERTIFICATE OF COMPETENCY

This is to Certify that

Douglas M. Fitzpatrick

SAMPLE

of

Augusta Area Technical School

has successfully mastered the competencies required to perform the job of ELECTRICIAN.

Joel Pitts

June 10, 1981

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Electrician.

ELECTRICIAN
824.261-010

RESIDENTIAL WIRING

Identifying basic electrical theory
Installing single 115 volt duplex outlets
Wiring multiple convenience outlets
Wiring a switch controlled convenience outlet
Installing three wire branch circuits
Identifying code requirements for a small appliance circuit
Installing split switched receptacles
Installing a circuit with four receptacles and one single pole switch
Installing five receptacles on a split circuit
Wiring one light with a single pole switch and one outlet
Wiring a lighting circuit with a single pole switch
Wiring two lights with a single pole switch
Wiring two three-way switches
Wiring two three-way switches with two lights
Wiring a four way switch controlling one light
Wiring a master switch
Identifying electrical symbols
Installing electrical symbols into a floor plan and estimating materials
Wiring light fixtures
Hanging light fixtures
Identifying principles and applications of transformers
Wiring low voltage transformers
Installing a push button switch
Installing bells and chimes
Wiring special low voltage circuits
Connecting 220 volt grounded outlets
Wiring a hot water heater
Wiring ranges
Wiring baseboard type wall heaters
Installing a 230 volt central heating and cooling circuit and disconnect
Calculating loads
Calculating wire size and voltage drop
Making calculations for three-wire branch circuits
Selecting conduit for service entrance
Installing an electrical service for single phase power
Installing a circuit breaker box (or a fuse box)
Wiring a switch box
Installing ground fault interruptors
Installing a temporary service entrance

TRANSFORMERS

Determining transformer polarity
Connecting to and operating dual voltage single phase transformers
Connecting single phase transformers in series
Connecting single phase transformers in parallel
Determining the KVA rating of transformers-single phase
Determining the KVA rating of transformers-three phase
Hooking up and operating a one phase auto transformer
Hook-up a one phase buck booster transformer
Hooking up a three phase booster transformer
Hooking up a three phase auto transformer
Hooking up a three phase transformer bank; Wye/Wye
Hooking up a three phase transformer bank; Delta/Delta
Hooking up a three phase bank of transformers; open Delta
Hooking up a three phase transformer bank; Wye/Delta
Hooking up a three phase transformer; Delta/Wye
Hooking up a three phase transformer bank; reversed voltage
Hooking up transformers for special applications

COMMERCIAL WIRING

Calculate service load for a small commercial building
Locating service entrance equipment and writing specifications
Selecting service entrance conductor
Calculating service conduits
Installing service conduit
Installing service entrance conductors
Selecting and installing meters
Selecting and installing panels
Calculating and installing motor branch circuits
Installing and operating subfeeders and panels
Grouping outlets onto branch circuits
Installing specific purpose outlets
Calculating branch circuit conductors and overcurrent protection
Installing branch circuits and controls for lighting
Selecting conduit
Installing conduit under a concrete slab
Installing outlet, junction and conduitlets
Installing branch circuits and controls for air conditioning and heating
Selecting and installing branch circuits for 3 phase water heaters

INDUSTRIAL WIRING

Planning and performing site work for a small industrial facility
Making calculations for electric motors, welders and heaters
Calculating the 120 and 277 volt lighting load
Calculating and selecting receptacles for 120/208 volt loads
Calculating size for and selecting and installing a buss - duct
Selecting and installing a 3 phase, 4 wire 480v panel
Selecting the correct transformer bank
Selecting and installing a 480v/208-120 3-phase 4 wire service
Installing metering equipment
Selecting and installing panels and selecting distribution equipment
Selecting and installing 277v fluorescent light
Determining sizes and types of feeders and overcurrent protection devices
Installing a branch circuit for welders
Operating a split phase motor
Operating a capacitor start motor
Operating a universal motor
Operating a 3 phase induction motor
Operating a 3 phase synchronous motor
Operating a 3 phase 1 winding, 2 speed motor
Operating single and three phase alternators
Operating an induction regulator
Operating a rotary frequency changer
Operating a synchronous rotary converter
Operating a rotary converter
Operating DC motors
Operating and checking load characteristics of DC generators
Correcting power factor
Hooking up and operating gear motors
Selecting correct machine drive
Installing ventilator fans
Identifying motor leads
Identifying hazardous wiring locations
Operating a power actuated tool

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of Electrician's Helper.

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Electrician's Helper.

ELECTRICIAN'S HELPER
829.684-022

RESIDENTIAL WIRING

Identifying basic electrical theory
Installing single volt duplex outlets
Wiring multiple convenience outlets
Wiring a switch controlled convenience outlet
Installing three wire branch circuits
Installing split switched receptacles
Installing a circuit with four receptacles and one single pole switch
Installing five receptacles on a split circuit
Wiring one light with a single pole switch and one outlet
Wiring a lighting circuit with a single pole switch
Wiring two lights with a single pole switch
Wiring two three-way switches
Wiring two three-way switches with two lights
Wiring a four-way switch controlling one light
Wiring a master switch
Wiring light fixtures
Hanging light fixtures
Selecting conduit for service entrance
Installing a circuit breaker box (or a fuse box)
Wiring a switch box
Installing a temporary service entrance

TRANSFORMERS

Connecting to and operating dual voltage single phase transformers
Connecting single phase transformers in series
Connecting single phase transformers in parallel
Determining the KVA rating of transformers - single phase
Determining the KVA rating of transformers - three phase

COMMERCIAL WIRING

Selecting service entrance conductor
Calculating service conduits
Installing service conduit
Installing service entrance conductors
Selecting and installing meters
Selecting and installing panels
Calculating and installing motor branch circuits
Grouping outlets onto branch circuits
Installing specific purpose outlets
Calculating branch circuit conductors and overcurrent protection
Installing branch circuits and controls for lighting
Selecting conduit
Installing outlet, junction and conduitlets

INDUSTRIAL WIRING

Operating a split phase motor
Operating a capacitor start motor
Operating a universal motor
Operating a 3 phase induction motor
Operating a 3 phase 1 winding, 2 speed motor
Operating a 3 phase 2 winding, 2 speed motor
Installing ventilator fans
Identifying motor leads
Identifying hazardous wiring locations
Operating a power actuated tool

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of ______Electrician______.

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Electrician.

ELECTRICIAN
824.261-010

RESIDENTIAL WIRING

Identifying basic electrical theory
Installing single 115 volt duplex outlets
Wiring multiple convenience outlets
Wiring a switch controlled convenience outlet
Installing three wire branch circuits
Identifying code requirements for a small appliance circuit
Installing split switched receptacles
Installing a circuit with four receptacles and one single pole switch
Installing five receptacles on a split circuit
Wiring one light with a single pole switch and one outlet
Wiring a lighting circuit with a single pole switch
Wiring two lights with a single pole switch
Wiring two three-way switches
Wiring two three-way switches with two lights
Wiring a four way switch controlling one light
Wiring a master switch
Identifying electrical symbols
Installing electrical symbols into a floor plan and estimating materials
Wiring light fixtures
Hanging light fixtures
Identifying principles and applications of transformers
Wiring low voltage transformers
Installing a push button switch
Installing bells and chimes
Wiring special low voltage circuits
Connecting 220 volt grounded outlets
Wiring a hot water heater
Wiring ranges
Wiring baseboard type wall heaters
Installing a 230 volt central heating and cooling circuit and disconnect
Calculating loads
Calculating wire size and voltage drop
Making calculations for three-wire branch circuits
Selecting conduit for service entrance
Installing an electrical service for single phase power
Installing a circuit breaker box (or a fuse box)
Wiring a switch box
Installing ground fault interruptors
Installing a temporary service entrance

TRANSFORMERS

Determining transformer polarity
Connecting to and operating dual voltage single phase transformers
Connecting single phase transformers in series
Connecting single phase transformers in parallel
Determining the KVA rating of transformers-single phase
Determining the KVA rating of transformers-three phase
Hooking up and operating a one phase auto transformer
Hook-up a one phase buck booster transformer
Hooking up a three phase booster transformer
Hooking up a three phase auto transformer
Hooking up a three phase transformer bank; Wye/Wye
Hooking up a three phase transformer bank; Delta/Delta
Hooking up a three phase bank of transformers; open Delta
Hooking up a three phase transformer bank; Wye/Delta
Hooking up a three phase transformer; Delta/Wye
Hooking up a three phase transformer bank; reversed voltage
Hooking up transformers for special applications

COMMERCIAL WIRING

Calculate service load for a small commercial building
Locating service entrance equipment and writing specifications
Selecting service entrance conductor
Calculating service conduits
Installing service conduit
Installing service entrance conductors
Selecting and installing meters
Selecting and installing panels
Calculating and installing motor branch circuits
Installing and operating subfeeders and panels
Grouping outlets onto branch circuits
Installing specific purpose outlets
Calculating branch circuit conductors and overcurrent protection
Installing branch circuits and controls for lighting
Selecting conduit
Installing conduit under a concrete slab
Installing outlet, junction and conduitlets
Installing branch circuits and controls for air conditioning and heating
Selecting and installing branch circuits for 3 phase water heaters

INDUSTRIAL WIRING

Planning and performing site work for a small industrial facility
Making calculations for electric motors, welders and heaters
Calculating the 120 and 277 volt lighting load
Calculating and selecting receptacles for 120/208 volt loads
Calculating size for and selecting and installing a buss - duct
Selecting and installing a 3 phase, 4 wire 480v panel
Selecting the correct transformer bank
Selecting and installing a 480v/208-120 3-phase 4 wire service
Installing metering equipment
Selecting and installing panels and selecting distribution equipment
Selecting and installing 277v fluorescent light
Determining sizes and types of feeders and overcurrent protection devices
Installing a branch circuit for welders
Operating a split phase motor
Operating a capacitor start motor
Operating a universal motor
Operating a 3 phase induction motor
Operating a 3 phase synchronous motor
Operating a 3 phase 1 winding, 2 speed motor
Operating single and three phase alternators
Operating an induction regulator
Operating a rotary frequency changer
Operating a synchronous rotary converter
Operating a rotary converter
Operating DC motors
Operating and checking load characteristics of DC generators
Correcting power factor
Hooking up and operating gear motors
Selecting correct machine drive
Installing ventilator fans
Identifying motor leads
Identifying hazardous wiring locations
Operating a power actuated tool

SECTION VIII

SPECIAL NEEDS STUDENT

WORKING WITH SPECIAL NEEDS STUDENTS

Introduction

Special needs students are those who are designated as handicapped and/or disadvantaged. The 1976 vocational education amendment defines handicapped individuals as:

> Persons who are mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, health impaired, or persons with other specific disabilities, who by reason thereof require special education and related services and who cannot succeed in the regular vocational education programs.

In Title II of the 1976 education amendments disadvantaged persons are defined as:

> Persons (other than handicapped persons) who have academic or economic disadvantages and who require special services, assistance or programs in order to enable them to succeed in vocational education programs.

Federal legislation requires that these special people be given an opportunity to function in a regular classroom. This section provides information on how special needs students are identified and how they can be mainstreamed into regular educational environments.

Figure One presents a model depicting various activities of the process in identifying and mainstreaming special needs students. These activities are conducted at three levels: the system level, the school level and the classroom level. All three levels must work together if implementation of the process is to be effective.

Identification Of The Special Needs Student

Through a variety of pre-testing procedures, special needs students are identified and their potentials are evaluated at the

SPECIAL NEEDS MAINSTREAMING MODEL

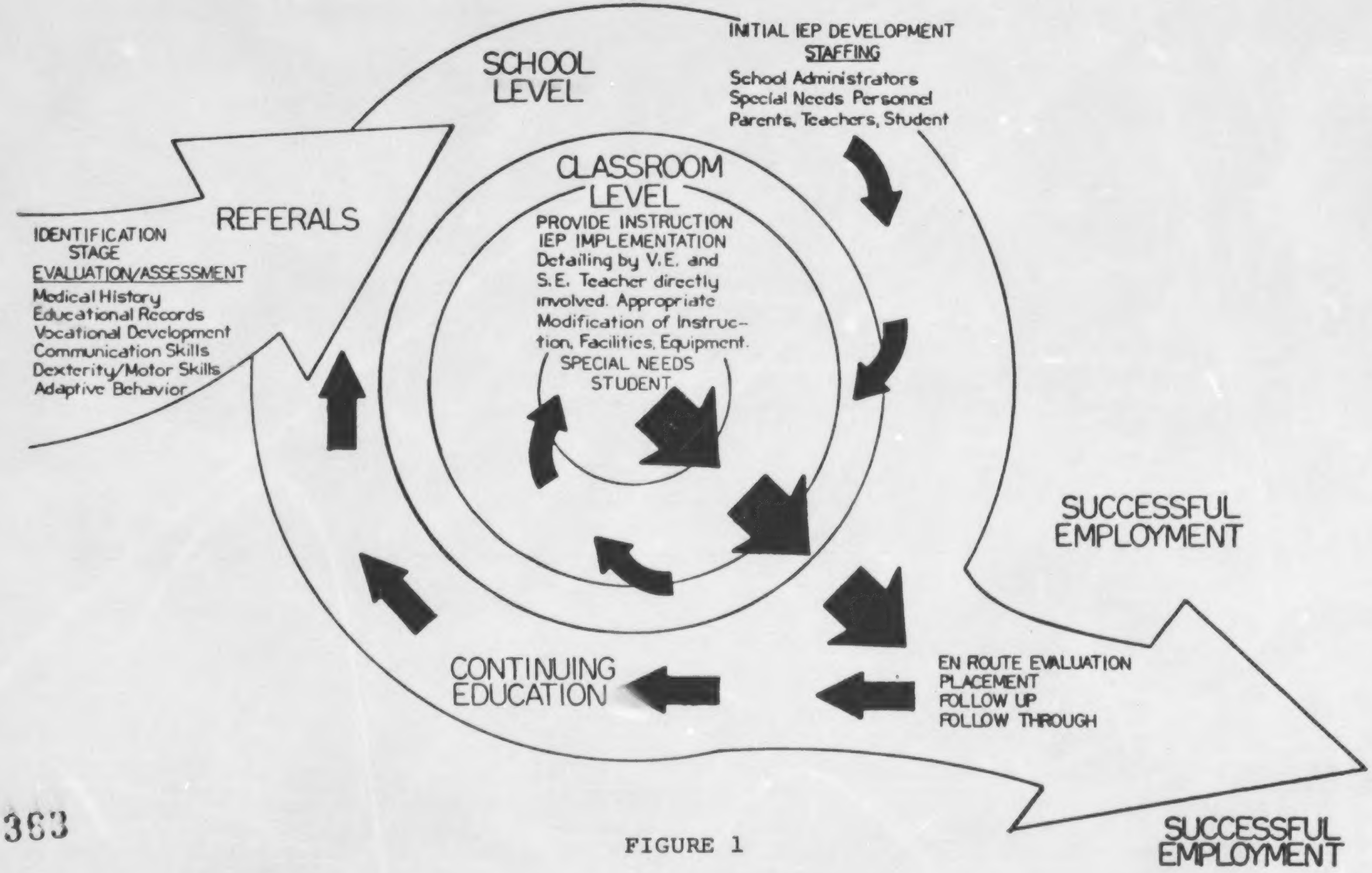

SCHOOL LEVEL
INITIAL IEP DEVELOPMENT
STAFFING
School Administrators
Special Needs Personnel
Parents, Teachers, Student
REFERALS
IDENTIFICATION STAGE
EVALUATION/ASSESSMENT
Medical History
Educational Records
Vocational Development
Communication Skills
Dexterity/Motor Skills
Adaptive Behavior
CLASSROOM LEVEL
PROVIDE INSTRUCTION
IEP IMPLEMENTATION
Detailing by V.E. and S.E. Teacher directly involved. Appropriate Modification of Instruction, Facilities, Equipment.
SPECIAL NEEDS STUDENT
SUCCESSFUL EMPLOYMENT
CONTINUING EDUCATION
EN ROUTE EVALUATION
PLACEMENT
FOLLOW UP
FOLLOW THROUGH
SUCCESSFUL EMPLOYMENT

FIGURE 1

system level. This evaluation process consists of collecting and assessing the following data for each student:

-Medical History
-Educational Records
-Vocational Development
-Communication Skills
-Dexterity/Motor Skills
-Adaptive Behavior

When this procedure has been completed, the system personnel refers the student to the appropriate school level personnel.

Development of the Plan

At the school level, an Individual Education Plan (IEP) is developed for each special needs student. An IEP is a written plan which describes the educational objectives, both long and short term, and the support services for a special needs student. The plan is developed by the school administration, special education personnel, teacher(s) directly involved with the student and the parent(s). In some cases, the student may help with the development.

Implementing the I.E.P.

The actual implementing of the I.E.P. begins at the classroom level. The purpose of the teacher dealing with the special needs student is to help the student set realistic goals, identify the barriers which make it difficult for the student to learn and adapt the curriculum and/or facilities with reference to the I.E.P. so the student can learn while overcoming personal barriers.

Special needs students have problems which hinder their learning. Therefore, a teacher's job becomes more complicated than when teaching "regular" students. Handicapped students may have a variety of problems - mental, physical and/or emotional.

Academically disadvantaged students may exhibit language deficiencies, reading and writing deficiencies, computational deficiencies and general educational deficiencies. Economically disadvantaged students may possess an inability to concentrate because their primary needs - food, shelter, clothing - are not adequately met due to lack of money.

By considering these problems, teachers can modify existing programs to accommodate the needs of special needs learners. Some suggestions which may prove beneficial in modifying an existing curriculum are listed below:

- Prepare instructional materials in greater detail and assign work in shorter units.
- Provide more frequent evaluation of student's progress and provide opportunities for remedial work.
- Be aware of the student's limited vocabulary.
- Be aware of the student's inability to understand abstractions and generalizations and prepare materials accordingly.
- Keep the student aware of his or her progress and make the student feel he or she can succeed.
- Use real teaching aids, live work and practical experiences whenever possible.
- Choose reading material which is at the student's level, interest and experience.
- Use constructive criticism only.
- Use peer instruction whenever possible.
- Allow the student to advance at his or her own pace.
- Use the part-to-whole learning concept in adapting materials.

Materials Which Can Be Used to Teach Disadvantaged

In Georgia an effective set of materials has been developed to be used with a program to help disadvantaged students adjust to life and work situations. This program is called CVAE or Coordinated Vocational Academic Education. The CVAE program is organized with a coordinator who is responsible for the type of instruction the students receive, and a team of teachers assigned to the coordinator who work cooperatively to help the disadvantaged students learn to enjoy school and become more successful students. CVAE materials include visuals in the form of synchronized slide/tape presentations. These units are designed to help the disadvantaged student become more successful in school, learn good work habits, become an aware consumer, and develop a better self-image and appearance. (Although designed especially for disadvantaged students, CVAE may also be used in regular classroom situations). The vocational education teacher should work with the CVAE coordinator to design a program of study for the disadvantaged students in areas in which the student needs help.

In some cases, facilities, must be modified for handicapped special needs students. In general, as long as the classroom/shop meets federal guidelines for barrier free design, extensive facility changes need not be made. For visually impaired students, for example, let the student locate in the classroom where he or she can see best even to the point of moving the desk or work station as a portable unit. In the case of orthopedically handicapped, some changes may have to be made to shop machinery to allow the student to use it. This may involve more convenient controls or special seating where the student would normally stand. In making these changes, special education expertise would be helpful.

Evaluation

Evaluation of the student's program should consist of:

-En-route evaluation (formative) to monitor the student's progress through the program.

-Summative evaluation upon completion of the program to determine job readiness.

-Follow-up after placement to determine if the student is successful on the job.

-Follow-through activities designed to identify any further training needed, which is indicated by the follow-up procedure.

Working with special needs students is much more demanding of the system, the school and the classroom teacher. However, with their patience and understanding, special needs students can not only succeed, but in many cases excell.

RESOURCES

To aid the teacher in modifying materials for special needs categories, the following references are listed by category. These are suggested references only as a world of materials exist on this subject.

Mentally Retarded

A Curriculum Guide for Teachers of Educable Mentally Retarded. Danville, Ill.: The Interstate Printers and Publishing Co., Inc.

High, Elizabeth C., and Moyers, Kathy L. Training Manual: Developing Pre-Vocational/Vocational Skills in Developmentally Disabled Persons. Washington, D.C.: Job Development Laboratory, George Washington University, 1976.

Kolstoe, Oliver P. Teaching Educable Mentally Retarded Children. Holt, Rinehart and Winston, 1976.

Mulligan, Robert E.; Gavin, Donald and Conaley, James. Comprehensive Career Education Curriculum Guide for the Trainable. New Brunswick, N.J.: Rutgers Vocational-Technical Curriculum Laboratory, 1977.

Introduction to Vocations for Educable Mentally Retarded. New Jersey: New Jersey Department of Education.

State of Ohio Curriculum Guide for Moderately Retarded Learners. Columbus, Ohio: Ohio Department of Education, 1977.

Tucker, Mark M. Learning through Curriculum Modification; A Blueprint to Teaching the Mentally Retarded. Johnstown, PA.: Mafex Associates, Inc., 1976.

Watson, Marjorie. Mainstreaming the Educable Mentally Retarded. Washington, D.C., NEA, 1975.

Hearing Impaired

Alvin, Howard P. The Evolution of an Evaluation Design for Evaluating Secondary Programs for the Deaf in Vocational Occupational-Technical Education (VOTE) Programs. ERIC - ED 123-241.

Guidelines: Educational Planning for the Hearing Handicapped. North Carolina Public Schools. Division for Exceptional Children, North Carolina Department of Public Instruction, Raleigh, N.C., 1977.

Munson, Harold L.; Eglston, Judy Cobb and Phillips, Gordon B. Career Education for Deaf Students: An Inservice Leader's Guide. University of Rochester, College of Education, Center for the Study of Helping Services, Rochester, N.Y. 1975.

Nix, Gary W. Mainstreaming Education for Hearing Impaired Children and Youth. Grune and Stratton, 1976.

Orthopedically and Other Health

A Model Plan for a Cooperative Vocational Rehabilitation Program. Office of Human Development, Rehabilitation Services and Administration. Department of Health, Education and Welfare, Washington, D.C.

Mallix, Kalisanker and Mueller, Jim. Vocational Aids and Enhanced Productivity of the Severely Disabled. The George Washington University Rehabilitation Research and Training Center, Washington, D.C. 1975.

McCarthy, Henry and Smart, Landon. Recommendations for Enhancing Employment Prospects of Handicapped Individuals. Comps. Human Resources Center, Albertson, L. I., 1978.

Duncan, John, et al. Environmental Modifications for the Visually Impaired: A Handbook. Visual Impairment and Blindness, December 1977, p. 442-455.

Disadvantaged

Guidelines for Methods and Techniques of Teaching Disadvantaged Students. Division of Vocational Education, Virginia Polytechnic Institute and State University, Blackburg, VA.

A Handbook for Developing Programs and Services for Disadvantaged Students. Department of Vocational Education Studies, College of Education, Southern Illinois, University of Carbondale, Carbondale, Ill. 62901

By Program

Adaption of Home Economics Curricula for Special Needs. North Dakota Research Coordination Unit, State Board for Vocational Education, State Office Building, Bismarck, ND.

Auto Body: An Adaptive and Developmental Program for Special Needs Students. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Floriculture Board of Cooperative Educational Services of Nassaw County, Division of Occupational Education, Division of Special Education, Westburg, NY 1975.

Grubb, Francine. Basic Business - A Teacher's Guide to an Employment Orientation Course for Special Needs Students. Vocational Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Home Economics and the Exceptional Student: A Handbook for Home Economics Teachers Working with Mentally Retarded Students. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Troutman, Carol M. Introduction to Office Occupations. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1974.

Working with the Handicapped in the Vocational Home Economics Classroom. Division of Vocational Education, State of Ohio, Columbus, Ohio.

Coordinated Vocational Education and Training (C.V.E.T.) manuals for disadvantaged, available from: Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1515 West Sixth Avenue, Stillwater, Oklahoma 74074.

-CVET Construction 3100219 Teacher's Guide
3100209 Student

-CVET General Mechanics 3100239 Teacher's Guide
3100229 Student

General Special Needs

A Handbook for Modifying Vocational Curricula for Handicapped Students. Wisconsin Vocational Studies Center, University of Wisconsin, Madison, May 1980.

Bottoms, J.E. and Scott, C.P. Supportive services for special student groups. In J.E. Wall (ed.), Vocational Education for Special Groups. Sixth Yearbook, Washington, D.C.: American Vocational Association, 1976.

Gill, Douglas H. and Scott, C. Paul. A practical model for mainstreaming handicapped learners in vocational education. The Journal for Vocational Special Needs Education, Vol. 1, No. 3, April, 1979, pp. 3-7.

Gugerty, J., et al. Tools, Equipment and Machinery Adapted for the Vocational Educator and Employment of the Handicapped. Project #498749006, Wisconsin Vocational Studies Center, Madison, Wisconsin, January 1981.

Hull, Marc E., Berry, Owen J. and Clark, Donald L. Procedures for Teaching Vocational Concepts to Students with Special Needs. Texas A & M University, Final Report Project 62350274, June 1976.

The Related Vocational Instruction Program. Georgia's Approach to Vocational Education for the Handicapped at the Secondary level, Douglas H. Gill, Project Coordinator, Vocational Programs for the Handicapped, Georgia Southern College, Statesboro, Georgia.

Vocational Educational Resource Materials, A Bibliography of Materials for Handicapped and Special Education. Third edition, 1978. Wisconsin Vocational Studies Center, University of Wisconsin - Madison.

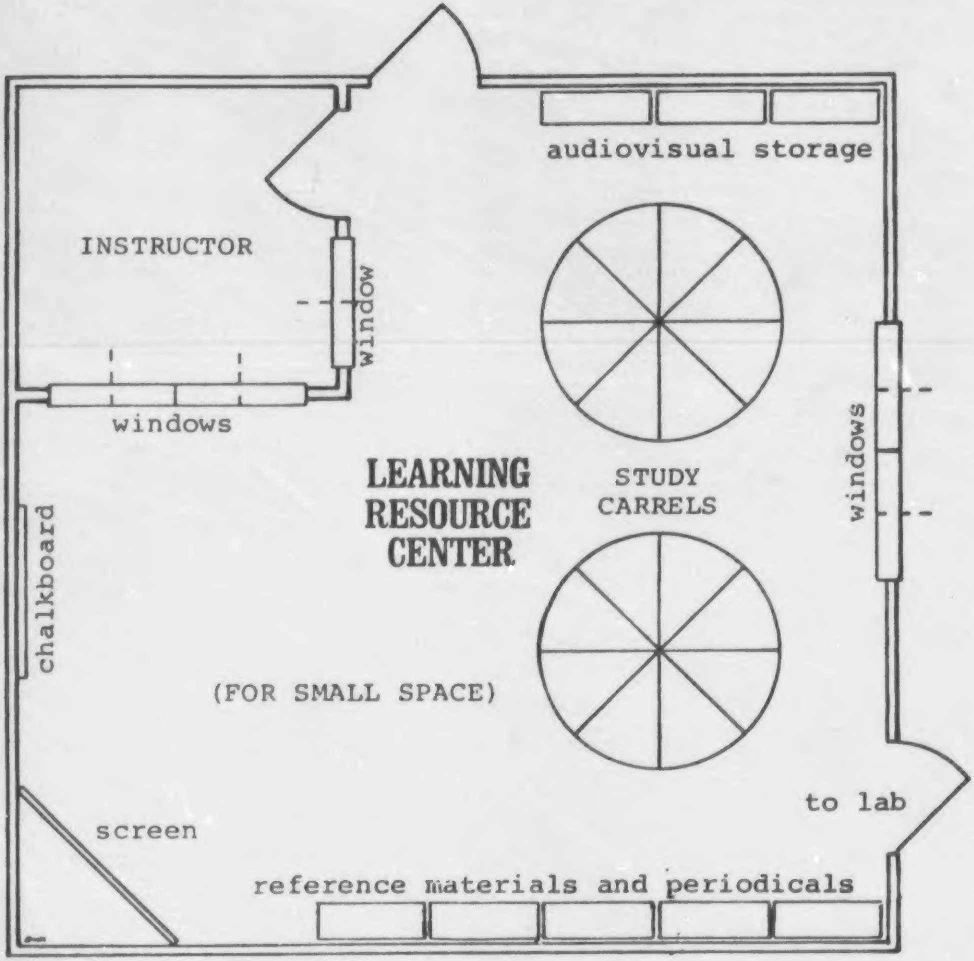
SECTION IX

FACILITY LAYOUT

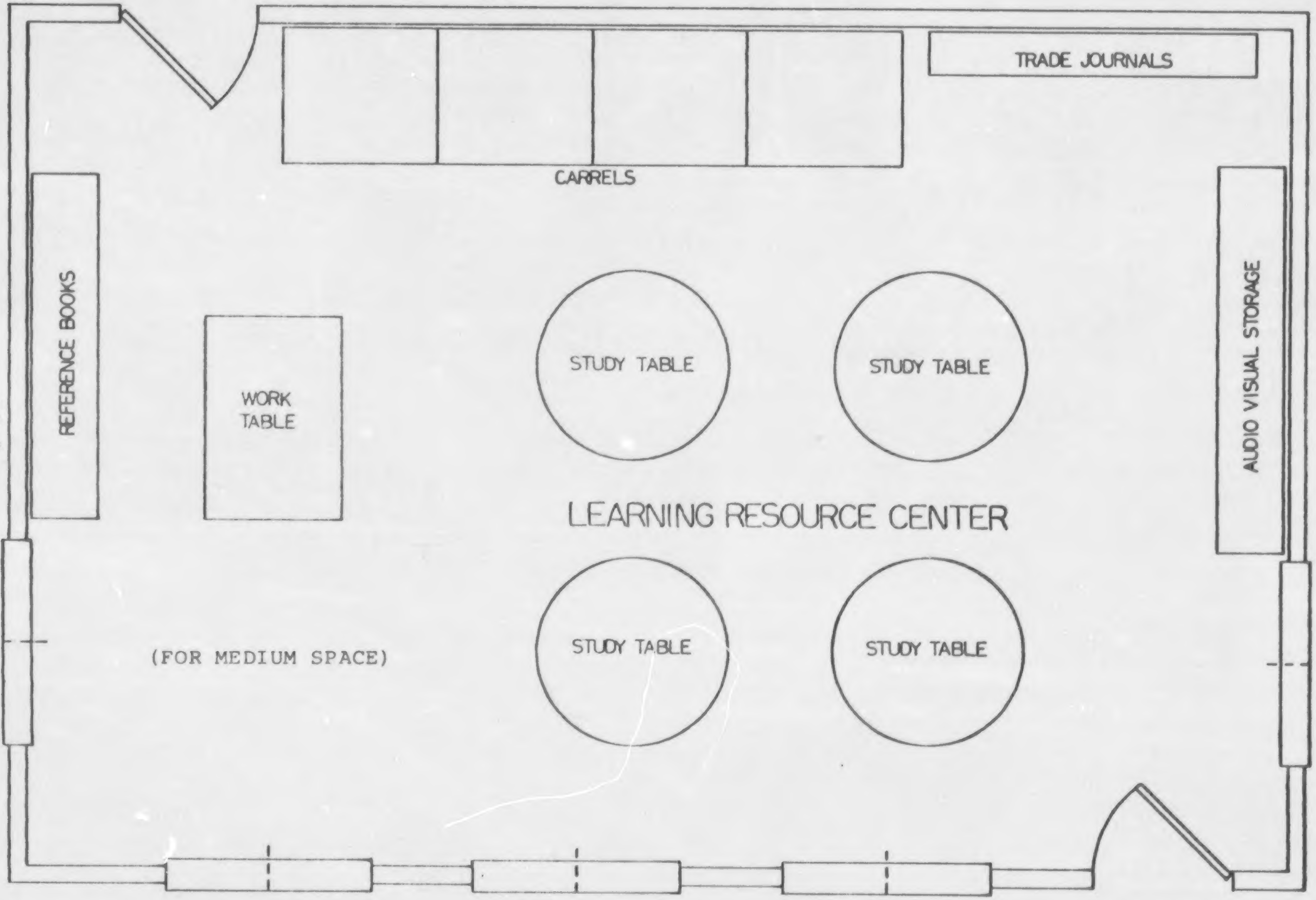
Facility Layout

The facility layouts on the following pages are presented to aid in arranging the classroom and laboratory for efficient instruction. One facility layout and three resource center arrangements are presented. Ultimately the instructor must determine an arrangement that best fits the needs of the students and the instructional method being used.

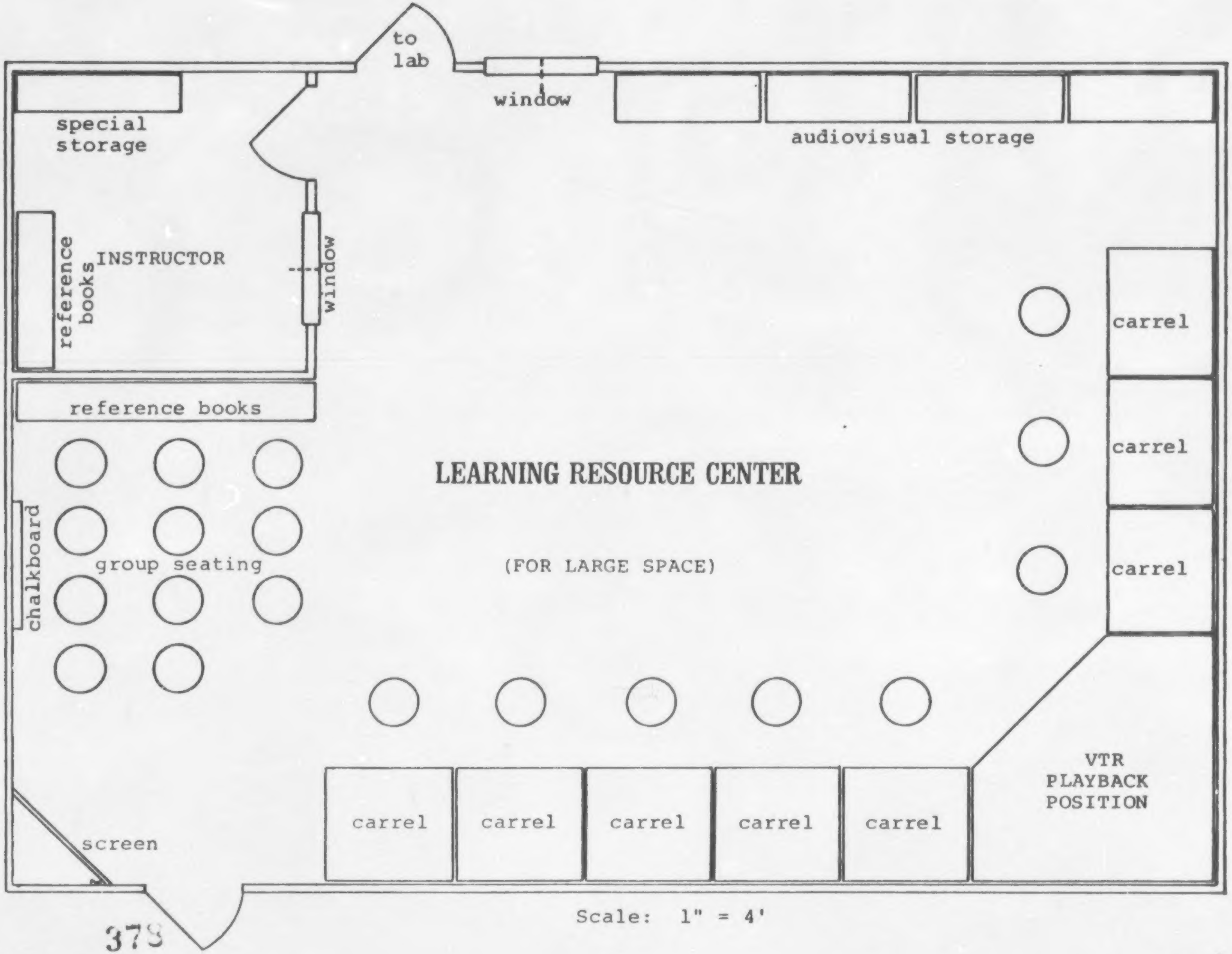
The laboratory facility layout is based on a successful program in Georgia. The facility should be easily adaptable to a variety of arrangements that will best fit local needs. These layouts may be especially useful in those schools where classroom renovation or construction is being planned.


audiovisual storage
INSTRUCTOR
window
windows
LEARNING
RESOURCE
CENTER
STUDY
CARRELS
windows
chalkboard
(FOR SMALL SPACE)
to lab
screen
reference materials and periodicals

Scale: 1" = 4'

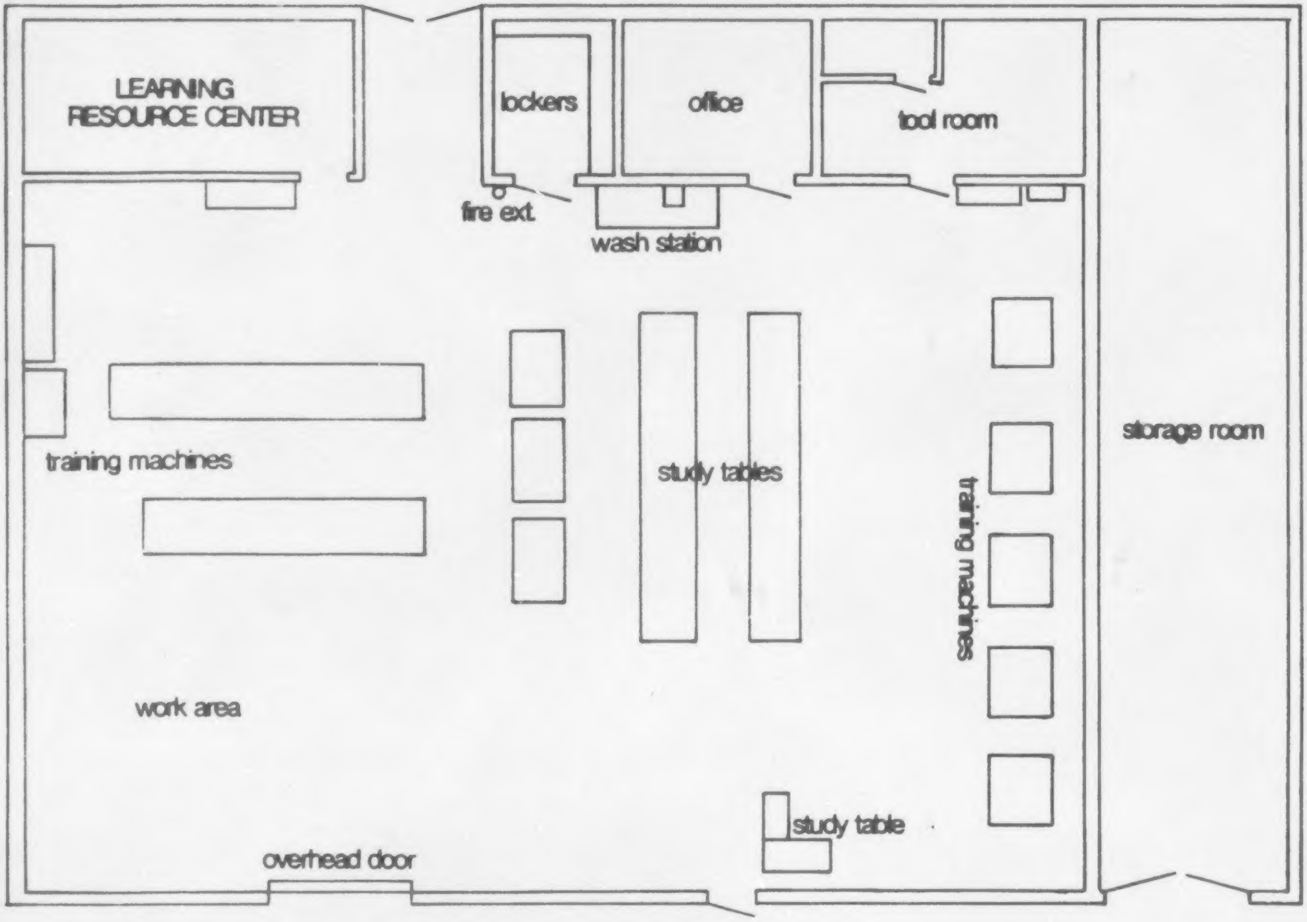

TRADE JOURNALS
CARRELS
REFERENCE BOOKS
WORK TABLE
STUDY TABLE
STUDY TABLE
AUDIO VISUAL STORAGE
LEARNING RESOURCE CENTER
(FOR MEDIUM SPACE)
STUDY TABLE
STUDY TABLE

IX-5


to lab
window
special storage
audiovisual storage
INSTRUCTOR
reference books
window
reference books
LEARNING RESOURCE CENTER
chalkboard
group seating
(FOR LARGE SPACE)
carrel
carrel
carrel
VTR PLAYBACK POSITION
carrel
carrel
carrel
carrel
carrel
screen

Scale: 1" = 4'

INDUSTRIAL ELECTRICITY LABORATORY


LEARNING RESOURCE CENTER
lockers
office
tool room
fire ext.
wash station
training machines
study tables
training machines
storage room
work area
study table
overhead door

SECTION X

DEFINITION OF TERMS

DEFINITION OF TERMS

1. AV's-Audiovisuals - May refer to any picture and/or sound media. (ie. slides, tapes, filmstrips, 16 mm films, etc.)

2. Checkpoint - A student-instructor interface point wherein the instructor may give the student a test, perform a demonstration, or simply provide the student with additional needed information or instructions. Also a checkpoint may be used for motivational purposes.

3. Competency - The ability (knowledge, skills and attitudes) to perform all of a group or cluster of related tasks required to complete a designated activity according to occupational standards. In the educational setting the statement of a competency includes expected student outcomes in terms of knowledge, skills, and attitudes required to complete a designated activity as defined by incumbent workers according to the standards of the work place.

4. Course - A grouping of tasks and competencies which have a common knowledge base or are within a given domain.

5. Criterion-Referenced Measure - An exercise based upon a performance objective, the accomplishment of which measures attainment of that objective.

6. Criterion-Referenced Test - A test designed to measure student competencies based on job or industrial standards.

7. Curriculum Guide - A document containing the objectives, content, organization, and structure of an instructional program. It is designed for use by administrators, instructional supervisors and teachers.

8. D.O.T. - Abbreviation for Dictionary of Occupational Titles. Document provides nine digit codes identifying each occupation.

9. Duty - One of the distinct major activities involved in the work performed, comprising related tasks.

10. Exit Point - A predetermined point within an instructional program in which a student may exit with the essential competencies for a specific job. Usually defined in terms of D.O.T. codes and/or O.E. codes.

11. "Hands-On" - Statement implying the student is physically involved in a learning activity.

12. Individualized Instruction (I.I.) - A system of instruction allowing for a student to progress at their fastest rate.

13. Job - A specific area of specialization within an occupational field consisting of several closely related duties for which a person would expect to receive remuneration. Should be identified by DOT code.

14. Job Sheet - (Or Operations Sheet) - A project of a performance nature. Generally performed by the student in a lab or shop type environment or in a specialized work area.

15. Live Work - Generally refers to items brought into the course area for repair or adjustment. Examples of live work might be automobiles, radios and TV's, air-conditioners, etc. Another form of live work would be patrons visiting the cosmetology department to receive permanents or other services.

16. Master Copies - Original copies of slides, tapes or written materials set aside for the purpose of duplication.

17. Occupational Cluster - A group of occupations sharing a common core of competencies. Georgia's comprehensive high school vocational program is organized around this concept.

18. Occupational Inventory - A listing of tasks to be performed in a particular occupational area, grouped under duty classifications.

19. O.E. - Refers to the U. S. Office of Education. O.E. codes are a classification system (taxonomy) for occupational education programs.

20. Open Entry - Term meaning that a student may enter the program at any time and does not have to wait for quarter or semester breaks.

21. Open Exit - Term meaning that a student may leave a program any time he/she completes their occupational objective.

22. Performance Guide - A series of steps, arranged in a sequence ordinarily followed, which when completed may result in the performance of a task. Also called "teaching steps."

23. Performance Objective - A statement in precise, measurable terms of a particular behavior to be exhibited by a learner under specified conditions. It possesses each of the elements or characteristics specified below:

    a. Condition - The testing situation confronting the learner is clearly specified. This includes equipment provided or withheld, environmental constraints such as temperature, space, etc.

    b. Performance - The specific behavior expected of the learner is stated.

    c. Standard - The degree of acceptable performance is specified.

24. Performance Test - A test entailing not only the ability to answer questions, but measuring the students' ability to operate, manipulate, or perform a given task as well.

25. Program - An organized sequence of courses leading to an occupational objective. A program may contain one or more student exit points as defined by D.O.T. codes.

26. Program Objective - The outcome of a prescribed program of instruction. Usually expressed in terms of the occupation or job for which training is designed. D.O.T. codes are frequently used to identify program objectives or student exit points.

27. Self-Paced - Refers to a student moving through the prescribed training program at the fastest pace at which the student can meaningfully learn.

28. Sequencing - Putting any set or series of learning activities or tasks into proper order or sequence. Normally arranged from the simple to complex within groupings or blocks.

29. Software - Written or printed materials, slides, filmstrips, tapes, etc.

30. Student Manual - A document designed for use by students in a specific instructional program. It contains unit sheets, references, operational procedures or job sheets, etc.

31. Task - The smallest division of work in which a measurable output occurs. A logical and necessary step in the performance of a duty.

32. Task List - A listing of tasks performed by incumbent workers within a domain of interest. An example is a listing of all tasks performed by an automotive mechanic or by a worker in ornamental horticulture.

33. Unit - One "module" training materials; generally covering one learning task and programmed on one Unit Sheet. May cover more than one lesson.

34. Unit Guide - A curriculum guide sheet that lists a task and objective with the instructional activities, instructional materials, evaluation and approximate time required for a student to successfully complete the task.

35. V-TECS Catalog - A comprehensive collection of performance objectives, performance guides, criterion-referenced measures, and related data, organized by a job structure or career ladder within a domain of interest.

Federal law prohibits discrimination on the basis of race, color or national origin (Title VI of the Civil Rights Act of 1964); sex (Title IX of the Educational Amendments of 1972 and Title II of the Vocational Education Amendments of 1976); or handicap (Section 504 of the Rehabilitation Act of 1973) in educational programs or activities receiving federal financial assistance.

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Title II - Loydia Webber, Vocational Equity Coordinator
Title VI - Peyton Williams Jr., Associate Superintendent
of State Schools and Special Services
Title IX - Evelyn Rowe and Myra Tolbert, Coordinators
Section 504 - Jane Lee, Coordinator of Special Education

Inquiries concerning the application of Title II, Title VI, Title IX or Section 504 to the policies and practices of the department may be addressed to the persons listed above at the Georgia Department of Education, State Office Building, Atlanta 30334; to the Regional Office for Civil Rights, Atlanta 30323; or to the Director, Office for Civil Rights, Education Department, Washington, D.C. 20201.